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AORTIC EMBOLISM

WILLIAM D. HOLDEN, M.D.
CLEVELAND

THE NUMBER of technically successful aortic embolectomies has been so few that reiteration of the problems arising seems to be worth while. McClure and Harkins [1] in 1943 presented a review of the entire subject of peripheral arterial embolism. No attempt will be made to add to their excellent summary of the literature. Nineteen successful aortic embolectomies were reported in their review. Five of these operations were performed transperitoneally, five retroperitoneally and seven by retrograde milking or by extraction through the femoral arteries; the method in two instances was not stated. In 1945 Linton [2] reported a successful aortic embolectomy and discussed in detail the technic of the transperitoneal approach. He also suggested manual manipulation of the embolus in one common iliac artery into the other for extraction through one arteriotomy.

The early clinical recognition of acute occlusion of the abdominal aorta is not difficult if an examination of the pulses in the lower extremities is performed. As in so many other surgical emergencies, optimum results are obtained with early diagnosis and early surgical intervention. Sudden pain, coldness, pallor and frequently loss of motor power are the usual symptoms. Palpation of the pulses and oscillometry should lead to a correct diagnosis. Dissecting aortic aneurysm, traumatic thrombosis and acute arteriospasm complicating venous thrombosis have to be considered. Careful elicitation of the history and examination should differentiate them. It may be impossible to differentiate acute thrombosis superimposed on an arteriosclerotic plaque or ulcer from acute embolic occlusion.

REPORT OF A CASE

J. K., a 58 year old white man, was admitted to the University Hospitals of Cleveland on March 3, 1947. The past history revealed dyspnea on exertion of two

From the Department of Surgery, Western Reserve University and University Hospitals of Cleveland.

1. McClure, R. D., and Harkins, H. N.: Recent Advances in the Treatment of Peripheral Arterial Embolism, Surgery **14**:747 (Nov.) 1943.

2. Linton, R. R.: Arterial Embolism: A Simplified Technique for the Removal of a Saddle Embolus at the Bifurcation of the Aorta with the Report of a Successful Case, Surg., Gynec. & Obst. **80**:509 (May) 1945.

years' duration and questionable diabetes mellitus. Six weeks prior to his admission he was given some "green pills" because of progressive dyspnea. One hour before admission he complained of severe pain in the lower portion of the back and abdomen, which proceeded into the lower extremities within a few minutes. His extremities became numb, cold and mottled blue and white. Within one-half hour after the onset, complete anesthesia developed from the midthighs distally. The upper part of the thighs, however, remained painful.

Physical examination immediately after the patient's admission to the hospital showed an acutely and chronically ill man. The temperature was 37.4 C. (99.3 F.) rectally, the pulse rate 80, the respirations 24 and the blood pressure 184 systolic and 98 diastolic. The skin was warm and moist except on the lower extremities. The heart was enlarged to the anterior axillary line on the left. No murmurs were heard. Auricular fibrillation was present. Moist fine rales were heard at the bases of both lungs posteriorly. The liver was palpable just below the costal margin. The lower extremities were pale, with a patchy type of mild cyanosis. This was observed principally below the midthighs but was also present on the upper parts. There was an abrupt decrease in the temperature of the skin on the midthighs. Femoral, popliteal and dorsalis pedis pulses were not palpable. No oscillometric pulsations could be recorded in either lower extremity.

The blood hemoglobin content was 10.5 Gm. per hundred cubic centimeters. The white blood cell count was 12,100. Urinalysis revealed sugar (2 plus) and a trace of acetone. An electrocardiogram showed auricular fibrillation at a ventricular rate of 90 and digitalis effect.

The patient was taken to the operating room and given 14 mg. of weighted tetracaine hydrochloride intrathecally. No change in the appearance or temperature of the extremities was observed. A suprapubic incision was made. The patient was placed in the Trendelenburg position and the intestines packed into the upper abdominal cavity. Exposure of the aorta and the common iliac arteries showed no pulsations below the first centimeter of each common iliac artery. At these sites the vessels were distended, and rubbery intraluminal masses were palpable. Normal pulsations were present above, and the vessels below the division of the common iliacs were soft and did not appear to contain a thrombus. The right ureter was mobilized and gently retracted. The right common iliac artery was occluded by means of a small rubber tube above the palpable mass. The external and internal iliac arteries were similarly occluded below the mass. A 1 cm. longitudinal incision was then made in the common iliac artery over the mass. A 3.3 by 1 cm. organized embolus was lying free in the vessel and was easily extruded. The rubber tubes on the internal and external iliac arteries were loosened, and blood flow was obtained. The tube above on the common iliac artery was then loosened and a gush of blood obtained. An attempt was then made to milk the embolus in the left common iliac artery back into the aorta and then into the right side. It could not be dislodged without what was considered to be undue trauma. A tourniquet about the aorta might have permitted this maneuver. The tubes on the right side having been retightened, the opening was closed with a single, everting, running suture of arterial silk. The edges of the opening were not grasped with any instrument. Before closure was completed, the lumen was filled with isotonic solution of sodium chloride. After the tubes were released, there was no leakage and pulsations were transmitted into both external and internal iliac arteries. The same procedure was performed on the left side. Immediately after closure of the left common iliac artery, 50 mg. of heparin was administered intravenously. The vessels were

observed for five minutes. No leakage was seen, and the abdominal wall was closed in layers with silk 00.

At the close of the operation the color of the extremities was within normal limits and excellent pulsations in all major arteries were palpable. Pulsations were maintained up to the time of the patient's death on the twelfth postoperative day. Six hours after operation he had no pain and complete return of motor power in the lower extremities. He was encouraged to move in bed freely. Fifty milligrams of heparin was administered every four hours for the first four days. Thereafter, 100 mg. was given at midnight, followed by 50 mg. every four hours during the day. This was continued through the eleventh postoperative day. The

Fig. 1.—The lumen of the left common iliac artery is seen with the suture line free of thrombi.

patient remained dyspneic, and on the fourth postoperative day there was electrocardiographic evidence of an anterior myocardial infarct. Cardiac decompensation developed which did not respond satisfactorily to digitalis, mercurophylline injection, theophylline ethylenediamine and oxygen. His diabetes was controlled with small doses of insulin and with diet.

On the eleventh postoperative day his respiratory rate became rapid, and an electrocardiogram showed extension of the previous myocardial infarct. On the twelfth postoperative day, he became cyanotic and markedly dyspneic. Peripheral vascular collapse occurred, and he died.

Autopsy showed moderate arteriosclerosis of the coronary arteries, with recent thrombosis of the anterior descending branch of the left coronary artery. There

was an organizing thrombus of the posterior descending branch of the right coronary artery and an organizing myocardial infarct of the posterior aspect of the left ventricle. A recent embolus in a small pulmonary arterial branch in the lower lobe of the right lung was found. No thrombi were observed at the suture lines (figs. 1 and 2) in the iliac arteries, and the arteries of both lower extremities were patent. No source for the small pulmonary embolus was encountered.

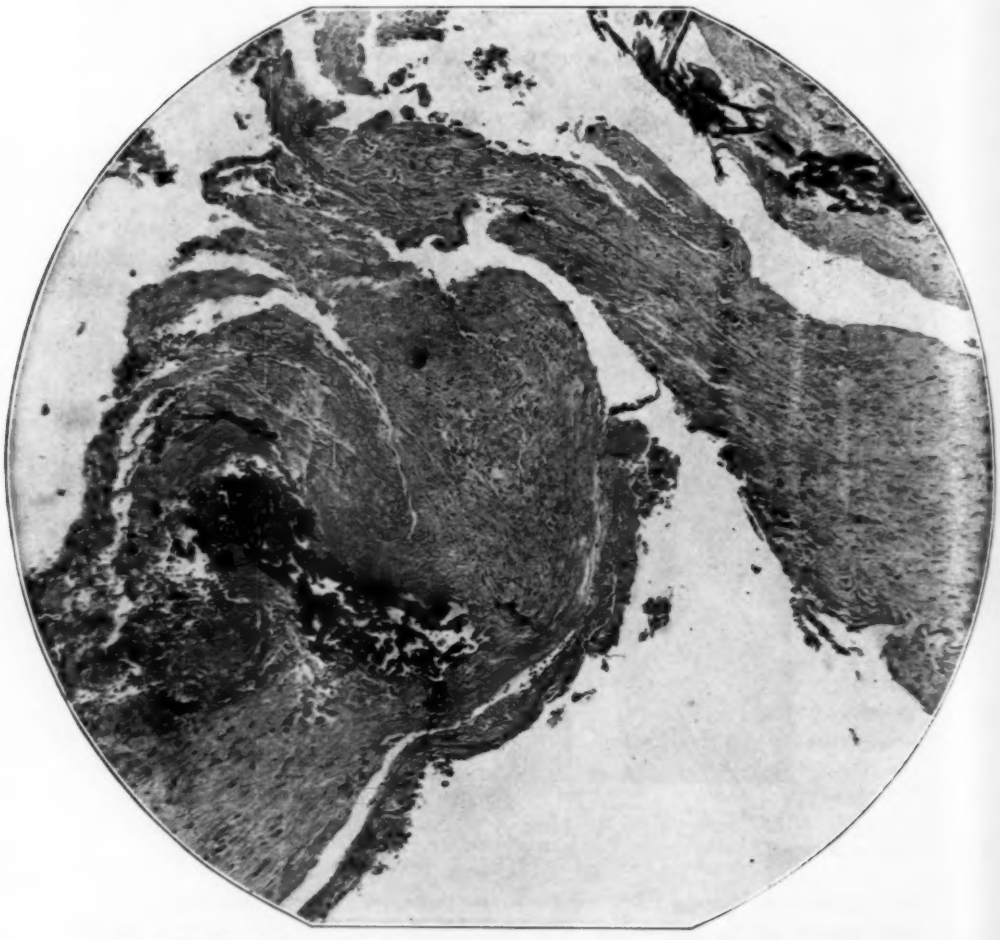

Fig. 2.—The microscopic appearance of the right common iliac artery is seen. The section is cut transverse to the axis of the artery and through the arteriotomy wound. The eversion of all layers of the arterial wall may be observed. The two deeply stained masses are silk sutures.

COMMENT

The main difficulties encountered in the successful treatment of peripheral arterial embolism have been secondary thrombosis at the suture line, venous thrombosis and pulmonary embolism, episodes of either embolism or thrombosis elsewhere in the arterial system and the

problem of early diagnosis. Careful atraumatic surgical procedures and the use of heparin have done a great deal in the past ten years to encourage the surgeon to assume a more optimistic attitude toward peripheral embolism. Postoperative thrombosis or embolism elsewhere should be treated as vigorously as the primary embolism. The early recognition of acute peripheral arterial occlusion can be obtained only by impressing its importance on medical students and on resident staffs. The decision to utilize conservative therapy or surgical exploration is difficult in many instances even for the vascular surgeon. The patient whose extremity may be preserved by embolectomy should not be denied the opportunity. This opportunity is lost, however, if many hours elapse between the time of occurrence and surgical intervention.

HISTOLOGIC BASIS FOR ANACIDITY IN GASTRIC DISEASE

LEWIS W. GUISS, M.D.
AND
FRED W. STEWART, M.D.
NEW YORK

CAUSES for anacidity in various forms of gastric disease have constituted the basis for numerous studies, and different conclusions have been reached. Such studies go back many years. Among the earlier workers were Ewald,[1] who observed complete anacidity in the presence of total atrophy of the gastric mucosa, and Einhorn,[2] who recognized anacidity as a functional nervous disorder. Martius [3] visualized it as a congenital defect.

Among the more outstanding proponents of chronic gastritis as the major cause of true anacidity were Faber [4] and his co-workers. Faber determined that ranges of gastric acidity coincided excellently with anatomic changes observable through anatomic investigations of gastritis. "Anacidity is certainly a natural consequence in the severe atrophic forms, but in the less advanced cases we cannot estimate the degree of secretion disturbance from the anatomic picture."

That other influences may be involved as causes in some cases of true achlorhydria is admitted by even the most enthusiastic supporters of chronic gastritis as the principal etiologic factor. That avitaminosis may be implicated is suggested by the incidence of anacidity in as many as 90 per cent of cases of pellagra and by the data of Lindgren [5] and Odin,[6] who found an incidence of achlorhydria of approximately 68 per

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Dr. Guiss is a Fellow of the National Cancer Institute.

From the Pathology Laboratories of the Memorial Hospital.

1. Ewald, C. A.: Ein Fall von Atrophie der Magenschleimhaut mit Verlust der Salzsäure-Secretion: Ulcus carcinomatosum duodenale, Klin. Wchnschr. **23**: 527, 1886.

2. Einhorn, M.: On Achylia Gastrica, M. Rec. **41**:650, 1892.

3. Martius, F.: Achylia gastrica, Leipzig, F. Deuticke, 1897.

4. Faber, K.: Gastritis and Its Consequences, London, Oxford University Press, 1935.

5. Lindgren, S.: Eine Studie über depressive Sekretions—anomalien des Magens, auf Grund eines vom Bevölkerungsstandpunkt einheitlichen Materials aus der Provinz Väslerbotten im Nördlichen Schweden, Acta med. Scandinav., 1932, supp. 48, pp. 1-235.

6. Odin, M.: Socialhygienisk undersökung i Västerbottens och Norrbottens län., Del. II, Lund, 1934.

cent among persons on a diet deficient in vitamin B complex. The latter condition is apparently reversible, since when the patients were placed on adequate diets some 42 per cent of them exhibited a reappearance of free hydrochloric acid in the gastric content.

Brunschwig and his co-workers [7] have suggested that the achlorhydria present in cases of gastric carcinoma might be due to a concentration of a gastric secretory depressant, which can be demonstrated in extracts of cancerous stomachs and of stomachs of patients with pernicious anemia and in extracts of the gastric secretion of such stomachs. They objected to the gastritis-anacidity hypothesis, partly on the basis of the finding of apparently normal gastric mucosas in some persons with true anacidity, and called attention to the fact that despite the moderate to severe gastritis found in some cases of peptic ulcer there is usually a normal and sometimes a high production of hydrochloric acid.

Barrett [8] in a recent paper made the following generalization:

> Achlorhydria is a common condition. It is not present at birth, tends to appear in early adult life and increases in incidence steadily to old age. In this regard it resembles gastritis, but the incidence is much less. Unlike gastric cancer, achlorhydria is somewhat more common in women than in men. Achlorhydria, like gastritis, is a frequent concomitant of diseases other than gastric cancer. Nevertheless more achlorhydria is found in association with gastric cancer than would be found in a group of the same age from the general population. Twenty to twenty-five per cent of the general population of gastric cancer age have achlorhydria whereas gastric cancer patients have an incidence of more than 50%.

Various observers [9] have found little or no correlation between the size of the gastric carcinoma, the site of the neoplasm and the quality of the gastric secretion. These divergent opinions expressed by so many careful investigators would seem to make further investigation into the problem worth while.

MATERIAL

The gastric specimens on which this report is based were carefully collected and prepared for a study of chronic atrophic gastritis and are therefore equally suitable for the present study. Five groups of stomachs

7. Brunschwig, A.; Schmitz, R. L., and Rasmussen, R.: Experimental Observations on Achlorhydria of Gastric Cancer, J. Nat. Cancer Inst. **1**:481, 1941.

8. Barrett, M. K.: Avenues of Approach to the Gastric-Cancer Problem, J. Nat. Cancer Inst. **7**:127, 1946.

9. Shay, H.; Gershon-Cohen, J., and Fels, S. S.: Gastric Acidity: Its Physiologic and Clinical Significance and Its Management, Am. J. Digest. Dis. **8**:115, 1941. Shapiro, N.; Schiff, L.; Maher, M. M., and Zinninger, M. M.: Some Observations on Atrophic Gastritis and Gastric Cancer, J. Nat. Cancer Inst. **2**:583, 1942. Comfort, M. W., and Vanzant, F. R.: Gastric Acidity in Carcinoma of the Stomach, Am. J. Surg. **26**:447, 1934. Brunschwig, A., and Clark, T. H.: Histologic Structure of Carcinomas of the Stomach and Quality of Gastric Secretions, Ann. Int. Med. **13**:1001, 1939.

for which figures on gastric analysis were available were collected. Group A was composed of 32 stomachs resected for duodenal ulcer, group B of 19 stomachs with prepyloric ulcers, group C of 20 stomachs resected for peptic ulcer of the body of the stomach, group D of 92 gastric specimens resected for carcinoma arising in the pyloric gland area and group E of 113 stomachs with carcinoma involving the fundus gland area.

The number and the anatomic distribution of the parietal cells in the various specimens were studied and were correlated with the degree of gastritis present. Special attention was directed toward the problem of whether any changes could be detected in the cell structure which might be interpreted as suggesting that they were nonfunctional even though anatomically intact. The results were then compared with those of gastric analyses obtained prior to gastric resection to determine possible correlation.

The size and site of the gastric lesions were also taken into consideration to ascertain if these factors might have any significant bearing on the problem of production of hydrochloric acid.

OBSERVATIONS

Considerable variation in the appearance of the parietal cells was observed. Although it is true that the parietal cells are usually the last specialized cells to remain in the fundus glands of severely injured stomachs, it is questionable whether mere histologic integrity connotes functional ability to produce normal acid ranges. Dawson [10] noted that after irradiation of the stomachs of dogs the parietal cells as a rule appeared unharmed although there was often cytolysis of the chief cells. However, since no hydrochloric acid was secreted, he felt that the parietal cells must be profoundly affected physiologically although morphologically they were relatively intact. He noted that there was considerable variation in the staining qualities of the parietal cells in the mucosa after regeneration from irradiation. Many stained normally, rendering the granules conspicuous, while the granules in other, palely stained cells were not easily distinguished. The nuclei of these pale cells were small and homogeneous, and they stained densely, in distinct contrast to the well defined chromatic reticulum and nucleolus of the normal cell. Similar changes in the parietal cells of severely damaged mucosas were found in our own material. After correlation of the appearance of the parietal cells with the known production of hydrochloric acid as indicated by the figure for free hydrochloric acid obtained in the gastric analyses, it became evident that unless the acidophilic granules could be clearly made out in properly stained sections the

10. Dawson, A. B.: Histological Changes in the Gastric Mucosa of the Dog Following Irradiation, Am. J. Roentgenol. **13**:320, 1925.

parietal cells were probably physiologically inactive. Considerable vacuolization and poor staining qualities of the cytoplasm probably also signify some functional abnormality within the parietal cell, but as long as the acidophilic granules were clearly evident, it appeared that the cells could probably still function in acid production.

Correlation of Intensity of Gastritis with Number of Parietal Cells.—The number of parietal cells present in the fundus mucosa was correlated with the gastritic changes in the fundus of the same specimens. Since the only pertinent information desired was the manner in which variations in intensity of chronic atrophic gastritis in the fundus affect the number of parietal cells present, all the groups were combined. The coefficient of correlation was -0.719 ± 0.020, a highly significant high negative correlation. In other words, as the intensity of chronic atrophic gastritis in the fundus increases, there is a proportionate decrease in the number of parietal cells present.

Correlation of Free Hydrochloric Acid of Gastric Analysis with Number of Parietal Cells.—The number of "functional" parietal cells present in the fundus mucosa was correlated with the highest figure for free hydrochloric acid obtained by fractional analysis of gastric material from the same patients. Because of the possibility of inhibition of secretion of hydrochloric acid in the carcinomatous stomachs by a gastric secretion–inhibiting substance, the stomachs were divided into two groups, one containing those with peptic ulcer and the other those with cancer.

The coefficient of correlation between the number of parietal cells present in the fundus of the ulcer group and production of free hydrochloric acid was $+0.622 \pm 0.083$, a high positive significant correlation. Accordingly, the production of hydrochloric acid in the stomachs of ulcer patients is proportional to the number of parietal cells present in the fundus of their stomachs; the more parietal cells present, the greater the tendency toward high amounts of free hydrochloric acid.

The coefficient of correlation between the number of parietal cells present in the fundus of stomachs with cancers and the production of free hydrochloric acid was even higher, i. e., $+0.718 \pm 0.0413$, a highly significant high positive correlation. Therefore the production of hydrochloric acid in the cancer-bearing stomach is directly proportional to the number of normal-appearing parietal cells present in the fundus of these stomachs. Although the coefficient of correlation is higher in the cancerous stomachs than in the ulcerous stomachs, the difference is not statistically significant.

It was noted that in some instances stomachs contained a minimal or small number of normal-appearing parietal cells, yet never contained any free hydrochloric acid when the gastric analysis was made. It

seems probable that some free hydrochloric acid was secreted in these specimens but that it combined with the mucus and other gastric contents and was not titratable. If it were possible to recover the small amount secreted in these specimens, the already high correlation would probably be even higher.

Effect of Location of Lesion on Production of Free Hydrochloric Acid.—No correlation could be obtained between the location of the lesion in cancer of the stomach and the production of free hydrochloric acid. This, however, was to be expected, since it has been shown in a preceding paper [11] that in general the gastritis in cancer of the stomach is a pangastritis. The degenerative changes in the fundus mucosa are of the same intensity, without regard to the location of the cancer, and since production of hydrochloric acid is dependent on the intact parietal cell, there should be little or no association between this production and the location of the cancer.

It has also been shown that in cases of peptic ulcer of the duodenum and the antral area the fundus is essentially devoid of chronic atrophic gastritis whereas in cases of peptic ulcer of the fundus gland area moderate gastric changes are found in the fundus mucosa.[12] The figures for free hydrochloric acid in our study closely paralleled this incidence of gastritis with reference to the location of the lesion.

Relation of Size of the Lesion to Production of Hydrochloric Acid.—Little or no relation was found between the size of the lesion and the free hydrochloric acid except that when the lesion was large enough to destroy or affect the major portion of the fundus mucosa anacidity naturally resulted.

This lack of correlation between the size and location of the cancer and production of hydrochloric acid corresponds to the findings of other workers who have reported on the subject and of course is due to the fact that the degenerative gastritic changes and the consequent damage to parietal cells in cancer of the stomach are generalized in nature and not dependent on the size and location of the lesion.

This finding of chronic atrophic gastritis and parietal cell deficiency as the primary cause of anacidity also explains the greater incidence of anacidity with increasing age in the general population, since the frequency and intensity of chronic atrophic gastritis are known to progress with age.[11] That additional causes for anacidity may be operative is not denied, but the material studied afforded no means of elucidation of these.

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11. Guiss, L. W., and Stewart, F. W.: Chronic Atrophic Gastritis and Cancer of the Stomach, Arch. Surg. **46**:823 (June) 1943.

12. Guiss, L. W., and Stewart, F. W.: Distribution of Gastritic Changes Accompanying Gastric Cancers in Various Locations, Arch. Surg., this issue, p. 624.

SUMMARY

1. The number of normal-appearing parietal cells in the mucosa of the gastric fundus is directly dependent on the degree of chronic atrophic gastritis present. Increases in the intensity of the gastritis result in a proportionate decrease in the number of parietal cells.

2. The production of hydrochloric acid and the figure obtained for free hydrochloric acid on gastric analysis are directly proportional to the number of normal-appearing parietal cells present in the fundus mucosa.

3. The degenerative changes of chronic atrophic gastritis are the basic cause of hypoacidity and anacidity in gastric disease.

4. It is not necessary to postulate the influence of a gastric secretion inhibitory factor to explain the hypoacidity and anacidity associated with gastric carcinoma. The variations in secretion of hydrochloric acid correspond to proportionate variations in the number of normal-appearing parietal cells present in the fundus mucosa.

5. The high figures for free hydrochloric acid obtained on gastric analysis in cases of duodenal and prepyloric peptic ulcer are due to the relative freedom of the fundus from gastritic changes.

6. The figures for free hydrochloric acid obtained by gastric analysis properly done may be considered a valuable index to the degree of degenerative gastritic change present in the fundus of the stomach.

444 East Sixty-Eighth Street.

DISTRIBUTION OF GASTRIC CHANGES ACCOMPANYING GASTRIC CANCERS IN VARIOUS LOCATIONS

LEWIS W. GUISS, M.D.
AND
FRED W. STEWART, M.D.
NEW YORK

THE AUTHORS of this paper have previously reported their investigation of the incidence of chronic atrophic gastritis in "normal" and abnormal stomachs and of its etiologic relationship to cancer of the stomach.[1] At that time the mucosa of each stomach was dealt with as a whole and little consideration was given to variations in the distribution of the changes in the various specimens. There has been considerable comment in the literature on the importance of differences in the location of the gastritis associated with various types of gastric lesions in an effort to ascertain any significant associations. Since the previous report it has been possible to augment greatly the amount of material, properly collected and prepared, which would be suitable for such a study. In view of the importance which has been attributed to variations in the distribution of gastritis and since a great deal of new material was available for analysis, it was considered worth while to restudy the old material and to observe the new specimens with this particular point in mind.

Orator[2] and Puchert[3] have both commented on the fact that the gastritis seen in cases of cancer of the stomach was a severe pangastritis involving the entire mucosa. They also noted that in peptic ulcer the fundus mucosa was largely spared, the gastritis being mostly limited to the antrum. It was on this difference in the distribution of the gastritis that they based their diagnosis of ulcerocancer, since they felt that if the fundus mucosa was not involved in the gastritis the lesion must have originated as a peptic ulcer and undergone secondary neoplastic change.

Dr. Guiss is a Fellow of the National Cancer Institute.

From the Pathology Laboratories of the Memorial Hospital.

1. Guiss, L. W., and Stewart, F. W.: Chronic Atrophic Gastritis and Cancer of the Stomach, Arch. Surg. **46**:823 (June) 1943.

2. Orator, V.: Beiträge zur Magenpathologie, Virchows Arch. f. path. Anat. **255**:639, 1925; **256**:202 and 230, 1925.

3. Puchert, H.: Ueber die Magenschleimhaut bei Geschwür und bei Krebs, Virchows Arch. f. path. Anat. **280**:385, 1931.

Eusterman [4] cited Baker as having found pangastritis in all specimens of gastric carcinoma. He also found that 90 per cent of gastric ulcers and 80 per cent of duodenal ulcers showed some degree of antral gastritis.

Hebbel [5] reported an antral gastritis in all his specimens resected for ulcer and noted that changes in the body mucosa were rare in the specimens of duodenal ulcer but common in those of gastric ulcer. He found that the gastritic changes in stomachs resected for carcinoma were extremely variable.

Faber [6] also wrote of the "pyloric gastritis" seen in association with "juxtapyloric" ulcer, making little or no differentiation between duodenal and pyloric ulcers.

Torgersen [7] in a study of the localization of gastritis and gastric cancer stated that gastritis originates in the region of the pyloric glands and gradually spreads orally. He found that most cancers arose in the pyloric mucosal areas and cited other authors who placed the incidence of cancer of the pyloric area as high as 75 per cent of the total. He also made the interesting observation that cancer in the region of the pyloric glands was relatively more frequent in younger persons. He felt that this was due to the fact that gastritis originates in that region.

The suggestion has been made that the changes which characterize chronic atrophic gastritis do not occur evenly throughout the stomach but are more marked in certain areas. Specifically, these degenerative changes have been thought to be much more pronounced in the pyloric gland area, especially along the lesser curvature, to be present to a moderate degree along the lesser curvature of the body of the stomach and to be more or less absent along the greater curvature of the body and in the cardiac portion of the stomach. (They have already been proved to increase in amount and intensity with advancing age.[1])

Assuming for the purpose of speculation that this were true and assuming for the same purpose that there might be some causal relationship between chronic atrophic gastritis and the development of gastric carcinoma, it would be only reasonable to expect that gastric carcinoma in the pyloric area would develop at a significantly earlier age than carcinoma of the body and that carcinoma of the cardia of the stomach should develop at an even more advanced age.

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4. Eusterman, G. B.: The Gastritis Problem: Notes on Histologically Verified Cases, South. M. J. **29**:685, 1936.

5. Hebbel, R.: Chronic Gastritis: Its Relation to Gastric and Duodenal Ulcer and to Gastric Carcinoma, Am. J. Path. **19**:43, 1943.

6. Faber, K.: Gastritis and Its Consequences, London, Oxford University Press, 1935.

7. Torgersen, J.: Localization of Gastritis and Gastric Cancer, Especially in Cases of Pernicious Anemia, Acta radiol. **25**:845, 1944.

Other writers have claimed that the chronic atrophic gastritis which is seen in association with peptic ulcers is different in distribution and intensity from that seen in carcinoma of the stomach. They hold that the gastritis of carcinomatous stomachs is a pangastritis, involving the entire mucosa, while that seen in conjunction with peptic ulcers is only a localized process about the lesion or limited to the antral mucosa. They utilize this assumed difference in the distribution of the gastritis to prove their diagnosis of "ulcerocancer," i. e., cancer arising in a peptic ulcer. Some of these statements have been made casually during the discussion of other findings, and no data have been given to support such statements, nor has any effort been made to verify them.

Certain questions naturally arise, as follows:

1. Is there a differential distribution of chronic atrophic gastritic changes present in the gastric mucosas of persons within the age range for gastric cancer?

2. Does cancer of one portion of the stomach develop earlier than that of any other portion?

3. Is there any difference in the distribution and intensity of the gastritic changes apparent in carcinomas of the various portions of the stomach, or is the "pangastritis" of carcinomatous mucosas a fact?

4. What gastritic changes appear consistently in association with peptic ulcers (*a*) of the duodenum, (*b*) of the pyloric area and (*c*) of the fundus?

5. Do the changes found in "ulcer stomachs" vary significantly from those found in "cancer stomachs" and in a control series of "normal stomachs" from persons in the same age range.

MATERIAL

The stomachs used as the basis for this study were especially collected and prepared for the study. All specimens were opened along the greater curvature, care being taken not to injure the mucosa, and fixed immediately in 4 per cent solution of formaldehyde. Routine sections were taken in every instance as nearly as possible according to the scheme previously reported. Sections were also taken from the centers and edges of all lesions, and additional sections of the mucosa were taken to insure an adequate sampling of the mucosa. The preparation and processing of the sections were identical with those used in the previously reported study so that accurate comparisons could be made.[1]

The material collected for the study was divided into seven distinct groups for study: Group A was a control group of 48 "normal" stomachs from persons who had no history or other indication of gastric disease. These persons were unselected except that they all fell within the age

range for gastric cancer, i. e., between the ages of 40 and 79. This selection was necessary to remove the age factor as a variable from the problem. It had been previously shown that degenerative gastric changes increase with advancing age [1]; so it was necessary that the mean age of the control group correspond with that of the other groups studied.

Group B consisted of 92 gastric specimens containing carcinoma arising in the pyloric portion. Considerable difficulty was encountered in many cases in determining just where the carcinoma originated. The sketches made of the lesion in the pathology department were compared with the roentgenologic and gastroscopic reports and with the description of the lesion at operation as dictated by the surgeon. If the probable site of origin was not definite, the specimen was excluded from the series.

Group C was made up of 67 specimens of carcinoma of the fundus excluding the "surgical cardia."

Group D was composed of 46 carcinomas of the "surgical cardia" of the stomach.

Group E consisted of 32 consecutive stomachs resected for duodenal ulcer.

Group F included 19 specimens of peptic ulcer located in the pyloric area.

Group G was a group of 20 stomachs resected for peptic ulcer of the fundus gland area.

SPECIFIC FEATURES STUDIED

Although many other histologic features were studied in these gastric specimens, the pertinent factors have been found to be (1) mucosal thickness, (2) type of glands and constituent cells with reference to location within the stomach, (3) number and size of lymphoid aggregates and follicles, (4) amount of leukocytic infiltrate, (5) amount of intestinal metaplasia and (6) amount and degree of dedifferentiation of specialized glands (pyloric gland heterotopia).

Reference to the previous paper on this subject should be made for definitions of these factors and for brief descriptions of the normal and abnormal histologic structure of the gastric mucosa. "The factors included in the present concept of chronic atrophic gastritis, i. e., mucosal atrophy, increased amounts of leukocytic infiltrate and lymphocytic aggregates, intestinal metaplasia and pyloric gland heterotopia, are all rather closely correlated, variation in one factor tending to be associated with proportionate changes in the others." [1]

OBSERVATIONS

All the findings and observations reported in this paper have been statistically analyzed by standard methods to determine whether they

are actually significant. Most of the observations are based on the comparison of means. Unless the difference between the pairs of means is four times or more the probable error of the difference between the two means, the difference is not considered significant in this paper. The odds against chance occurrence of their differences are at least 142 to 1, which is considered safely significant by biometrists.[8]

The mean ages and the mean mucosal thickness in millimeters of the various groups are given in table 1.

On comparison of the mean ages of the several groups, only one significant difference was found. The mean age of the duodenal ulcer group was found to be significantly less than that of all other groups, which can be interpreted as indicating that duodenal ulcer develops at an earlier age and requires surgical treatment at a definitely earlier age than the other lesions studied. This merely corroborates a generally accepted

TABLE 1.—*Mean Ages and Mean Mucosal Thicknesses*

Group	Number of Cases	Mean Age	Mean Mucosal Thickness, Mm.	
			Pylorus	Fundus
A. Control	48	54.2	1.05	1.09
B. Cancer of pyloric area	92	58.5	0.94	0.99
C. Cancer of fundus	67	56.5	1.00	1.03
D. Cancer of cardia	46	58.3	0.95	1.02
E. Duodenal ulcer	32	45.0	1.04	1.12
F. Pyloric area ulcer	19	57.2	0.91	1.06
G. Ulcer of fundus gland area	20	55.7	1.02	0.96

fact and has no bearing on the present problem. The only other inference that can be drawn is that cancer does not tend to develop at an earlier age in one specific part of the stomach than in the other parts.

The mean mucosal thicknesses of the pyloric and fundic areas of the various groups are also given in table 1. On statistical analysis, no significant differences are found in the mean thickness of the pyloric and fundic mucosa within the various groups, nor is any significant difference found in the mean mucosal thicknesses between the various groups. This does not controvert the fact that certain individual specimens may show considerable mucosal atrophy about a carcinoma or that certain other specimens may show mucosal thickening about a carcinoma or ulcer. It merely indicates that in general in large groups of cases the mucosal thickness is not significantly altered by the presence or absence of a gastric lesion and that such changes as are seen in association with gastric lesions may well be due to chance.

8. Pearl, R.: Introduction to Medical Biometry and Statistics, ed. 3, Philadelphia, W. B. Saunders Company, 1941.

Group A.—Examination of the control group of 48 "normal stomachs" from persons dying in the gastric cancer age range (40 to 79) showed that there was a low mean incidence of intestinal metaplasia and dedifferentiation of specialized glands, with no significant difference in the amount found in the pyloric and fundus gland areas. There was a slight to moderate amount of leukocytic infiltrate and lymphoid aggregates present in the same group, with a definitely decreased amount present in the fundus as compared to the pyloric area.

It is safe to say, then, that the average gastric mucosa of "normal" persons reaching the gastric cancer age measures around 1.00 mm. in thickness. There is a slight amount of intestinal metaplasia and glandular dedifferentiation scattered evenly over the pyloric and fundus areas. The only difference between the fundus and pyloric areas is that the amount of leukocytic infiltrate and lymphoid aggregates, small in the fundus area, is slightly but significantly increased in the pyloric area. It is necessary to assume, then, that chronic atrophic gastritis occurs with equal frequency and intensity in the pylorus and fundus of persons in the gastric cancer age range. The groups in which there were pathologic changes will be contrasted with the control group, the latter being used as a standard.

TABLE 2.—*Mean Amounts* of Metaplasia and Dedifferentiation, with Standard Deviations*

Group	Number of Cases	Pylorus		Fundus	
		Mean	Standard Deviation	Mean	Standard Deviation
A. Control	48	4.33	2.96	3.68	4.31
B. Cancer of pyloric area	92	14.46	6.28	10.98	8.22
C. Cancer of fundus	67	11.02	5.92	10.59	6.15
D. Cancer of cardia	46	13.01	4.62	6.06	5.98
E. Ulcer of doudenum	32	5.74	2.65	1.59	0.53
F. Ulcer of pyloric area	19	8.89	3.97	3.08	1.59
G. Ulcer of fundus gland area	20	10.22	3.79	9.00	4.95

* Graded on an arbitrary scale of 0, denoting complete absence, to 24, representing the maximal change possible.

An incidental but interesting finding was the distribution of the carcinomas in this study. It has always been thought and reported that carcinoma of the pyloric area is more common than carcinoma of the fundus. The figures have been largely based on series of resected stomachs. While the comparisons made were true of the series at that time, the fact that most carcinomas of the cardia were considered inoperable until recently was overlooked. The distribution in this series of gastric resections, namely, 98 carcinomas of the pylorus to 113 carcinomas of the fundus (including the cardia), reflects the extension of operability of gastric carcinomas by the addi-

tion of total gastrectomy and transthoracic cardiectomy to the older procedures. It will be of interest to see if other new figures published will verify the suggestion that carcinomas of the pylorus and fundus occur with equal frequency.

Group B and C.—These two groups, consisting of 92 specimens of carcinoma of the pyloric region and 67 specimens of carcinoma of the fundus respectively, can be treated together since the observed changes are essentially identical. The presence of a carcinoma in the stomach, irrespective of whether it was in the pyloric or in the fundic area, was associated with a moderate significant increase in intestinal metaplasia and glandular dedifferentiation. The intensity of the changes present in the pylorus and the fundus were essentially the same. Although the amount of leukocytic infiltrate and lymphoid aggregates

TABLE 3.—*Mean Amounts* of Infiltrate and Lymphoid Aggregates, with Standard Deviations*

Group	Number of Cases	Pylorus		Fundus	
		Mean	Standard Deviation	Mean	Standard Deviation
A. Control	48	15.39	5.20	9.58	5.73
B. Cancer of pyloric area	92	18.34	3.66	17.52	9.16
C. Cancer of fundus	67	16.16	4.15	17.24	6.09
D. Cancer of cardia	46	15.97	4.46	12.08	7.30
E. Ulcer of duodenum	32	21.52	3.80	4.33	3.29
F. Ulcer of pyloric area	19	25.98	3.81	10.00	5.36
G. Ulcer of fundus gland area	20	21.85	3.22	18.40	7.26

* Graded on an arbitrary scale of 0, denoting complete absence, to 36, representing the maximal change possible.

present in the pyloric area was not increased by the presence of cancer in either the pylorus or the fundus, the amount of infiltrate in the fundus (low in the control group) was so increased that the amounts were essentially the same in both areas (table 3). This should not be construed to mean that degenerative and inflammatory changes are not more severe in the mucosa immediately surrounding the cancer. It is an accepted fact that such changes are almost invariably present in the immediate vicinity of any gastric lesion, benign or malignant, and must be considered as due to the local lesion. These statements are based on consideration of the whole mucosa of the pyloric and fundic areas.

Group D.—The changes associated with the 48 carcinomas of the cardia are somewhat different. The pyloric mucosa showed the same moderate significant increase in intestinal metaplasia and the same lack of increase in the amount of infiltrate and lymphoid aggregates as in carcinoma of the prepyloric and fundus areas. However, the slight

increase in metaplasia, glandular dedifferentiation, leukocytic infiltrate and lymphoid aggregates which occcurred in the fundus in the presence of carcinoma of the cardia (the mucosal area nearest the carcinoma) was not significantly increased when compared with the amount found in the control group and was significantly less than the amount found in the presence of carcinoma of the fundus.

One may conclude, then, that there is a chronic atrophic gastritis of moderate degree present throughout the stomach which contains a cancer without regard to the location of cancer except that when there is carcinoma of the cardia the changes are less notable in the fundus.

Group E.—In this group of 32 stomachs from patients with an active duodenal ulcer only a few centimeters from the pyloric region of the stomach there was no increase in intestinal metaplasia or glandular dedifferentiation as compared with the control group; in fact, there was a consistent decrease in metaplastic changes in the fundus although this decrease is not statistically significant because of the small number of specimens studied. Also, although there was a real increase in the amount of leukocytic infiltrate and lymphoid follicles in the pyloric area in this group, there was again a significant decrease in these factors in the fundus. The presence of a duodenal ulcer, then, appears to have little or no association with degenerative changes in the gastric mucosa.

Group F.—In the group of stomachs bearing a peptic ulcer in the prepyloric area there was a significant moderate increase in the amount of intestinal metaplasia, leukocytic infiltrate and lymphoid aggregates limited to the pyloric mucosa as compared with the stomachs from the control group. In a comparison of the prepyloric ulcer group with the duodenal ulcer group, the only real difference found was an increase in the infiltrate in the fundus which was sufficient to bring it up to the control level. The presence of a prepyloric ulcer, then, is associated with mild atrophic and gastric changes localized in the vicinity of the ulcer.

Group G.—The group of 20 stomachs with ulcer in the fundus gland area presents an entirely different picture. Here there was a significant moderate increase in intestinal metaplasia, glandular dedifferentiation, leukocytic infiltrate and lymphoid aggregates in both parts of the stomach as compared with the control group. These changes were so pronounced that the mucosas of the group with ulcers of the body of the stomach could not be distinguished from those of the pyloric and fundic cancer groups. The presence of a peptic ulcer in the fundus gland area of a stomach is therefore associated with a generalized chronic atrophic gastritis of moderate degree, essentially the same as in the cancer groups.

SUMMARY

1. The mean age at which cancer develops in the various areas of the stomach is the same.

2. The average stomach of "normal" persons reaching the cancer age (40 to 79) shows a mild generalized chronic atrophic gastritis, with perhaps a slight intensification in the pylorus.

3. Cancer of the stomach, with the exception of cancer of the cardia, is associated with a generalized chronic atrophic gastritis of moderate degree, the gastritic changes being of equal intensity throughout the stomach without regard to the location of the cancer.

4. Although the chronic atrophic gastritic changes found in the presence of carcinoma of the cardia might be expected to be more severe in the fundus than in the pylorus, since chronic atrophic gastritis is usually felt to be associated with the presence of carcinoma, the amount actually present is not significantly increased over that found in the "normal" stomachs of persons in the same age group and is definitely less than that found in carcinoma of the body of the stomach.

5. The presence of a duodenal ulcer has little or no influence on the gastric mucosa.

6. Prepyloric peptic ulcers are associated with a mild atrophic chronic gastritis limited to the pyloric mucosa.

7. The presence of a peptic ulcer on the fundus gland area is associated with a generalized chronic atrophic gastritis of the whole stomach indistinguishable from that seen in carcinoma of the stomach.

444 East Sixty-Eighth Street.

CAMPTODACTYLY

BURNETT SCHAFF, M.D.
SWANNANOA, N. C.
AND
PAUL W. SCHAFER, M.D.
KANSAS CITY, KAN.

CONGENITAL flexion deformities of the fingers are not common, and yet Maurer [1] in 1938 described 31 cases, 21 of which were found in the examination of 6,000 school children. Congenital flexion deformity of the fifth finger seen late in life has often been mistakenly diagnosed as Dupuytren's contracture. Few articles on camptodactyly have appeared in the British or American medical journals in recent years, although as far back as 1885 von Landouzy had described the condition of bent fingers. For that reason, a brief survey of the present status of knowledge of camptodactyly is not amiss.

Whitman,[2] in his textbook on orthopedic surgery, suggested the term hammer finger for congenital contraction of the fingers. More recent writers seem to have preferred the term camptodactyly. This is derived from the Greek words *καμπτός*, meaning bent, and *δάκτυλος*, meaning finger. This term would apply to all flexion deformities of any or all of the fingers. Streblomicrodactyly, derived from *στρεβλός*, bent, and *μικρος δάκτυλος*, meaning little finger, has been suggested as a term for contractures involving only the little finger.[3] Thus streblomicrodactyly would refer to a particular type of camptodactyly. Hefner [4] described a family in which crooked little fingers exhibited less flexure than did those of previous studies and suggested the phrase minor

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From the Department of Surgery, Veterans Administration Hospital, Excelsior Springs, Mo. (Dr. Schaff) and the Department of Surgery, University of Kansas School of Medicine (Dr. Schafer).

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1. Maurer, G.: Die Kamptodaktylie, Arch. f. orthop. u. Unfall-Chir. **39**: 365-374 (Dec. 12) 1938.

2. Whitman, R.: A Treatise on Orthopedic Surgery, ed. 9, Philadelphia, Lea & Febiger, 1930.

3. Stoddard, S. E.: Nomenclature of Heredity Crooked Fingers, J. Hered. **30**:511-512 (Nov.) 1939.

4. Hefner, R. A.: Minor Streblomicrodactyly, J. Hered. **32**:37-38 (Jan.) 1941.

streblomicrodactyly. Hefner expressed the opinion that there might be a constancy in the transmission of the slight and the severe degrees of bowing of the fingers. Steindler [5] mentioned Goldflam's observations but classified the cases as instances of symphalangism, or fusion of the interphalangeal joints. This problem will be further discussed when the pathology of this condition is considered.

Of late, students of heredity have been interested in this deformity. The genetic aspect has been studied in several families, and there is suggestive evidence that the deformity is transmitted as a dominant factor. In one family, studied by Goldflam, 26 persons in three generations were afflicted. In 1918 Gassul [5a] reported on congenital contractures of the fourth and fifth fingers, symmetric in the two hands, through three generations, about 75 per cent of the family being involved. Moore and Messina [6] reported a series of 17 persons in four generations, of whom 8 exhibited deformity of one or both of the little fingers. They concluded that the deformity follows a dominant mode of inheritance. They also concluded that, since the deformity may skip a generation, "normal carriers" may occur. The gene involved in the production of the malformation is not linked with the x chromosome. Hefner also concluded that minor streblomicrodactyly was transmitted as a mendelian dominant trait by a heterozygous parent to one-half the offspring.

Streblomicrodactyly is manifested by flexion deformity of the fifth finger, noted shortly after birth. The contracture is located at the proximal interphalangeal joint and may be unilateral or bilateral. Usually the contracture is acute, but minor forms have been noted. The crooking is occasionally accompanied with a radial rotation of the involved digit. If we may judge from our experience and the reports in the literature, no motion occurs at the involved joint. This inability to extend one or both little fingers at the proximal interphalangeal joint is characteristic. Although the malformation most frequently occurs in the fifth finger, the fourth may also be involved. Sorrel [7] reported bilateral flexion deformities limited to the thumbs. It is interesting to note that Murphy [8] published an account of a family with acute flexion of one or more fingers. Some of these persons had associated subluxation of the knee joint, drop shoulder and overlapping toes. Roent-

5. Steindler, A.: Congenital Malformations and Deformities of the Hand, J. Orthop. Surg. **2**:635 (Dec.) 1920.

5a. Cited by Steindler.[5]

6. Moore, W. G., and Messina, P.: Camptodactylism and Its Variable Expression, J. Hered. **27**:27-30 (Jan.) 1936.

7. Sorrel, M. E.: Un cas de camptodactyle des deux pouces, Mém. Acad. de chir. **64**:638-632 (April 27) 1938.

8. Murphy, D. P.: Familial Finger Contracture and Associated Familial Knee Joint Subluxations, J. A. M. A. **86**:395-397 (Feb. 6) 1926.

genologic examination may reveal a normal proximal interphalangeal joint, but some patients examined later in life have shown secondary abnormalities in that area. Fusion of the interphalangeal joints has been reported as occurring early in life. Complete ankylosis appears to be rare. Occasionally the roentgenogram will reveal a subluxation of the second phalanx on the first. Mercer [9] also stated that in congenital contraction of the fingers there may be an extension of the metacarpophalangeal joint, in addition to the flexion at the proximal interphalangeal joint. He suggested that the coexisting extension at the metacarpophalangeal joint helps exclude the diagnosis of Dupuytren's contracture.

Bilateral flexion deformity of the fifth finger.

Sorrel [7] had an opportunity to operate on 2 patients with bilateral flexion deformity of the thumb and noted abnormalities in the flexor tendons. Maurer [1] reported his operative observation and also the observations of others who had had an opportunity to examine the deformed fingers after they had been amputated. He concluded that changes in the flexor tendons appear to have caused the deformity. Steindler [5] cited several articles in which cases of fusion of the interphalangeal joint were reported. Some of these cases appeared to be hereditary. Moore and Messina [6] offered the hypothesis that the defect is caused by an abnormality of the attachment of the expansion of the extensor of the little finger but gave no direct observations to confirm

9. Mercer, W.: Orthopaedic Surgery, ed. 3, Baltimore, Williams & Wilkins Company, 1943.

this view. Stoddard concluded that the inability to extend the finger was caused by shortness of the flexor tendons and not by a defect in the bone. Dupuytren's contracture, not infrequently mistaken for camptodactyly, appears later in life and involves the palmar fascia.

REPORT OF A CASE

History.—C. H., a white man aged 49, was admitted to the hospital for the treatment of a pulmonary neoplasm. On examination, a bilateral flexion deformity of the small finger was discovered (figure). There were no complaints referable to the contractures, although they had been present since birth. The only time any difficulty had been noted had been when, at the age of 11, the patient had had to milk cows on a farm. During his lifetime he had successfully worked for the railroads as a plasterer, painter and carpenter.

Examination.—The proximal interphalangeal joint of both fifth fingers was fixed in flexion at an angle of 90 degrees. A 50 per cent loss of abduction and adduction of both the fifth fingers was also noted. The affected fingers were normal in color and temperature; no fibrous bands were palpable on their flexor surfaces.

Roentgenologic study revealed that the proximal interphalangeal joint of each fifth digit was totally obliterated by fibrocalcific changes.

Hereditary Data.—The patient appeared to have inherited his deformity from his grandfather on his maternal side. This grandparent had a unilateral flexion contracture of his small finger. In addition to the patient's mother, there were 4 brothers and 4 sisters in the second generation, none of whom had any deformity. Of this group of aunts and uncles, we were able to trace 3 children; all were free of contractures. The patient had 2 brothers and 2 sisters. One of the brothers had a boy, and one of the sisters had 2 girls and 1 boy. The hands of the brothers and sisters and of their children were normal. The patient is the father of 2 normal children, a boy and a girl.

SUMMARY

A case of bilateral streblomicrodactyly is reported.

The terminology, genetic aspects and clinical features of camptodactyly are reviewed. The deformity was present in 2 of 25 members of four generations of the patient's family.

Veterans Administration Hospital.

PRESENT DAY TREATMENT OF THE POSTOPERATIVE DUODENAL FISTULA

J. REKAI, M.D.
BUDAPEST, HUNGARY

NONE of the methods suggested hitherto for suturing and burying the duodenal stump is able to prevent in every case the formation of a postoperative duodenal fistula. Not infrequently the fistula presents itself after operations in the course of which no technical difficulties arose in dealing with the stump; peritonization is rendered difficult on account of inflammatory, scarring and adhesive processes in the neighborhood of the ulcer. Besides the insufficiency of the secretion accumulating in the stump, there are peristaltic changes directed toward the anastomosis after operation, ischemia due to the occasional ligation of the pyloric and gastroduodenal arteries and diminished resistance of the duodenal wall owing to inflammatory and scarring processes.

Among the 96 cases collected by Kittelson [1] fistula was due to a previous operation performed on the gallbladder in 30 and to perforation of the duodenal ulcer in 22, whereas acute appendicitis played a role in 7, traumatic rupture of the duodenum in 8, preceding nephrectomy in 8, cancer of the stomach in 8 and miscellaneous factors in 7.

The treatment of the existing fistula has been much disputed. It is agreed that formation of the fistula, the most disagreeable sequel of the resection of the stomach, is mainly due to operation on an inflamed area, i. e., resection of a perforated stomach, and further that the treatment is one of the most difficult problems in surgery. The ancient problem of how long after perforation resection is permitted arises again. There is no space here to deal in detail with this problem. I agree with Donati that resection is to be performed even as late as twenty hours after perforation provided the duodenum is not too narrow for suturing. This standpoint may be supported by the fact that the mortality rate for gastroenteroanastomosis performed on perforated stomachs is higher than that for radical excision done in similar cases. Thus Lazzarini, reporting on 178 cases of perforation, gave mortality rates of 29, 36 and 25 per cent for simple suturing, suturing and anastomosis and suturing and excision respectively.

From the Second Surgical Department of the St. Rochus Hospital.

1. Kittelson, J. A.: Treatment of Duodenal Fistula: Report of New Buffer Solution, Surg., Gynec. & Obst. **56**:1056, 1933.

In the majority of cases one is dealing with a so-called external fistula appearing on the third to the seventh postoperative day. Its diagnosis is easy, since the duodenal content has a characteristic smell. In cases of small fistulas spontaneous healing within a short time is the rule. However, large fistulas are frequently followed, because of the loss of fluid, by exsiccation, symptoms due to the lack of digesting ferments and maceration and tissue necrosis in the surroundings of the fistula. The clinical pattern may resemble that observed in cases of high seated intestinal obstruction, and it often ends fatally after increasing alkalosis and a diminution of the serum chlorides associated with an increase of the blood urea concentration.

The condition ends fatally in a high percentage of cases. Mnuchin reported a 37 per cent mortality (172 cases) and Ricci [2] a 50 to 85 per cent mortaltiy.

Of the operative procedures, those suggested by Mayo, i. e., closure of the duodenum and jejunostomy or jejunostomy alone, may be recommended. Jejunostomy is favored by the fact that the fluid excreted through the fistula can be collected and introduced again through the opening. Though this operation is fatal in a high percentage of cases (Docimo [3] reported an 85 per cent mortality), it must be performed in all instances in which the conservative treatment has been tried without success and the condition of the patient becomes steadily worse. In no case was excision of the duodenum tolerated.

Many methods of conservative treatment have been promulgated. This alone is sufficient proof of the fact that none of them can be employed with success. Bailey applies a thin paste consisting of kaolin and glycerin to the surrounding areas of the wound, with an additional layer of kaolin on the paste. The dressing is changed every six hours. During the night the patient lies, without a dressing, on his abdomen on a stretcher placed on the bed. The duodenal fluid flows out and can be collected in a vessel without damage to the skin. Jakobovici [4] suggested roentgen treatment to promote the slow granulation of the fistula. Potter employs a sucking apparatus and washes out the fistula with a 1 to 3 per cent hydrochloric acid solution several times a day. He expressed the belief that the acid neutralizes the alkaline duodenal fluid maintaining the fistula. Zaccarini, Ricci, Virando and Pariset [5] administer insulin, dextrose solution by mouth

2. Ricci, G. F.: Su un caso di fistola colecisto-duodenale, Policlinico (sez. prat.) **45**:1314, 1938.

3. Docimo, L.: Ricerche sulla funzionalità epatica nelle affezioni dell'addome destro, Ann. ital. di chir. **16**:97, 1937.

4. Jakobovici: Le traitement radiothérapique des fistules duodénales post-opératoires, Rev. de chir. **43**:780-788, 1940.

5. Pariset, P.: Contributo clinico alla insulinoterapia della deiscenza del moneone duodenale dopo resezione gastrica, Arch. ital. di chir. **53**:442, 1938.

and by rectum and isotonic solution of sodium chloride to compensate for the fluid loss. Lafoucarde employs insulin as prophylactic treatment and administers 30 to 50 units daily in all cases in which insufficiency of the duodenal sutures is expected. The administration of insulin is based on the fact that it favors the retention of tissue fluids. In some cases good results have been obtained by the use of Zeissel's "necrolysin," a solution containing apathogenic proteolytic germs acting on the surrounding areas of the fistula opening in a sense which may be termed "biologic cleansing." Thompson [6] has suggested so-called capillary drainage, i. e., the use of a wide rubber tube 80 cm. in length lined with gauze which has a sucking action at the end of the tube. Further, he introduces a thin rubber tube into the upper wound recessus through which one-tenth normal hydrochloric acid, at a rate of 120 drops per hour, is brought into the fistula. The long rubber tube ends in a vessel lying at a deeper level which collects the duodenal fluid and the rinsing liquid. Vehrs [7] employs buffered aqueous solution of sodium hypochlorite for rinsing.

Kittelsohn was the first to suggest a buffered solution for the treatment of postoperative duodenal fistulas. Milk acidified by acidophile bacilli should be injected into the fistula and a dressing previously dipped in the same milk put on the wound. Some American authors recommend muscle extract acting as a buffer.

Pavlov, in the course of his experiments on dogs, repeatedly pointed to the fact that dogs with an experimental pancreatic fistula always suffered from excoriations of the skin, observed as early as on the second or third day after operation, and he stated that necrosis was due to the digestive effect on trypsin and erepsin. The question arises whether it would be possible to inactivate or destroy these proteolytic ferments. Theoretically it would be possible to wash the fistula and its surroundings with a fluid the p_H of which does not favor digestion of trypsin. Since the optimum p_H for trypsin digestion effect lies between 7.0 and 8.0, diminution of this effect might be expected in acid solutions. Selous and Perryman [8] applied acid buffer gels (p_H, 5.0) to the excoriated skin. Friedman [9] treated the skin with an aluminum hydroxide gel. The p_H of the gel acted unfavorably on the proteolytic ferment, while the gel substance exerted an absorbing and deodorizing effect.

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6. Thompson, L. R.: New Technique in Treatment of Duodenal Fistula, Am. J. Surg. **43**:783, 1939.

7. Vehrs, G. R.: Treatment of Three Duodenal Fistulas, West. J. Surg. **45**:453, 1937.

8. Selous, C. F., and Perryman, P. W.: Excoriation Around Fistulae, Lancet **1**:240, 1945.

9. Friedman, M. H. F.: Aluminum Hydroxide Gel for Erosions in Patients with Bowel Fistulas, J. A. M. A. **131**:520 (June 8) 1946.

A buffer solution called "optacid" employed as a preparation for combating abnormalities of gastric secretion has long been known in this country. The first report on its action appeared in 1934, written by Geréb and Körössy.[10] The preparation consists of sodium hydrosulfate and sodium dihydrophosphate in the proportion of 14:86, yielding a p_H of 2.8 to 3.2. The sodium hydrosulfate reacts with an equivalent portion of the sodium dihydrophosphate to give neutral sodium sulfate, with concurrent formation of phosphoric acid. The phosphoric acid thus liberated brings about a p_H which acidifies the fluid emptied though the fistula. There are in the buffer solution, besides the free hydrogen ions, a mass of bound ones (potentially available hydrogen ions) which, being present in an exceedingly high number, will be set free through dissociation after neutralization of the free ions by the alkaline fistula fluid and may for a time supply the acids disposed of. This process was observed in vivo by Rosenthal, who stated that the acidity maintained in an anacid stomach by "optacid" lasted longer than that maintained by hydrochloric acid of the same p_H because the neutralized hydrogen ions have been replaced by continuous dissociation of the buffer solution.

It was on the basis of these theoretical and practical experiments that the "optacid" treatment of the postoperative duodenal fistula was tried.

The patient was a 20 year old man who was transferred to the ward sixteen hours after perforation had occurred. He had been operated on because of a perforated ulcer of the stomach. At operation there were fluid and gastric contents in the abdomen and a thick adherent layer of fibrin about the duodenum and the pylorus. The site of the previous operation was full of scars and adhesions forming a conglomeration. The stomach was much dilated, and the pylorus was so narrow that it would become impermeable provided the ulcer were sutured. Therefore, excision of the stomach was performed according to the method of Pólya and Reichel despite the fact that perforation had taken place sixteen hours previously. The duodenal stump was closed with two rows of sutures, but peritonization was difficult because of the extensive scars and adhesions and was finally performed by pulling the omentum upward. The pancreas was put on the omentum as a protection. On the fourth postoperative day chills and fever occurred (temperature, 39 C. [102 F.]) and fluid began to flow through the tamponade, which was at first thick and sticky and then gradually became thinner and had a smell resembling that of duodenal secretion. A rubber tube was introduced, and the duodenal secretion, measuring about 1 liter daily, was aspirated, collected and returned into the alimentary tract of the patient through a duodenal sound introduced through the mouth. After forty-eight hours aspiration could not be continued because of an abundant bleeding through the sound. In spite of the fact that dressing was changed three times a day, excoriation of the skin ensued. Though the fistula opening and the surrounding areas were adequately treated with charcoal powder and petrolatum gauze, the excoriation gradually

10. Geréb, I., and Körössy, F.: Therapy of Gastric Secretory Disturbance with Buffer Compounds, Gyógyászat **74**:146, 1934.

spread. At this stage "optacid" treatment was instituted. One half of a pulverized tablet was applied to the wound and the other half to the neighboring area three times a day, that is, when the dressing was changed. Petrolatum was of course used as before. As early as the second day the spread of the excoriation stopped. The improvement was rather rapid, so that on the third day of the treatment it sufficed to change the dressing twice and on the seventh day only once. By the end of the third postoperative week the fistula which had destroyed the skin and the subcutis for the whole length of the wound was completely healed. It is noteworthy that some days before the patient became cured the temperature rose above 39.0 C. (102 F.) again and that both in the slide specimen and in the Löffler plate diphtheria bacilli were found. The patient was given serum, his temperature returned to normal and he left the ward on Feb. 28, 1946.

The result of this experiment induced me to try "optacid" as a buffer treatment in cases in which colostomy or cecostomy had been performed and in cases of stercoral fistula following operation on the perforated vermiform appendix. The results should be reported at a later time.

Fortunately, the postoperative duodenal fistula is a rare complication. Since its operative solution has proved hazardous, a kind of conservative treatment has been tried consisting in the employment of buffer solutions.

ORTHOPEDIC SURGERY IN THE ARMY AIR FORCES DURING WORLD WAR II

I. Introduction and Internal Derangements of the Knee

J. VERNON LUCK, M.D.
LOS ANGELES
HUGH M. A. SMITH, M.D.
MEMPHIS, TENN.
HENRY B. LACEY, M.D.
COLUMBUS, OHIO
AND
A. R. SHANDS Jr., M.D.
WILMINGTON, DEL.

IN MARCH 1942, the Air Surgeon was authorized by the War Department to recruit physicians from civilian practice for the Army Air Forces (A. A. F.) Medical Services. By December 1942, there were approximately ten thousand physicians in the Army Air Forces to staff hospitals and dispensaries and to act as flight surgeons. Of this number there were over two thousand, five hundred qualified medical specialists, with approximately one hundred classified as orthopedic surgeons with a military occupational specialty number (M. O. S. No.) of 3153. In this 3153 group, twenty-seven had been certified by the American Board of Orthopaedic Surgery, about forty had had two years or more of excellent training, each being ably qualified to be chief of an orthopedic section in a station or regional hospital, and the remainder had had from twelve to eighteen months in an orthopedic residency.

In December 1942, the senior orthopedic consultant to the Army Air Forces, Colonel Alfred R. Shands Jr., visited twenty of the larger

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These reports were made possible by the following officers: Major General David N. W. Grant, Medical Corps, the past Air Surgeon; Major General Malcolm C. Grow, Medical Corps, the present Air Surgeon; Colonel William P. Holbrook, Medical Corps, past Chief of the Professional Division, and Colonel William H. Powell Jr., the present Chief of the Professional Division, succeeding Colonel Holbrook.

hospitals in the Southwestern, Southern and Eastern states. After these visits, he recommended to the Air Surgeon that a consultant system be established in order that all of the two hundred and fifty-eight Army Air Forces station hospitals in the Continental United States, representing over seventy-five thousand hospital beds, might have orthopedic surgeons available for consultation when needed. Two thirds of these hospitals at this time had no orthopedic surgeon. A report on the clinical activities of these hospitals and the hospital to which the senior orthopedic consultant was assigned was published in the December 1943 issue of *Clinics*.[1]

In December 1943, the Office of the Air Surgeon established an area orthopedic consultant system. There were sixty orthopedic surgeons designated as area consultants who were made available to all Army Air Forces hospitals and dispensaries for consultation on orthopedic and fracture problems. This consultant system operated effectively for about nine months, until the regional hospital consultant system was established. When the regional hospital plan was started by the War Department in the latter part of the summer of 1944, each of the thirty Army Air Forces regional hospitals was assigned a certain number of satellite station hospitals. The chief of the orthopedic section in each regional hospital was then directed to visit as a consultant the satellite hospitals assigned to the regional hospital. In most instances this was done on a regular schedule until the end of the war. The original Army Air Forces area consultant system for orthopedics and fractures was the first regular consultant system in any medical specialty established in the Army below a command headquarters' level.

In June 1943, the senior orthopedic consultant recommended to the Air Surgeon that a series of fracture-orthopedic conferences be held during the fall of 1943 for the Army Air Forces medical officers and that the orthopedic surgeons of the Army Service Forces hospitals be invited to these conferences, in order that there might be a mutual discussion of common orthopedic problems. This plan was approved, and, during October and November 1943, twelve conferences were held in selected Army Air Forces hospitals with a uniform type of program. These were attended by one thousand, four hundred and sixty physicians from the Army Air Forces, the Army Service Forces, the Navy and civilian practice, an average of one hundred and twenty-two per conference. The more important information from these conferences was compiled and published in the October 1944 issue of *Surgery*.[2]

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1. Shands, A. R., Jr.: The Practice of Orthopaedic Surgery in the Army Air Forces in 1942 and 1943, Clinics **2**:966, 1943.

2. Shands, A. R., Jr.: An Analysis of the More Important Information Presented at the Twelve Regional Fracture Orthopaedic Conferences of the Army Air Forces, Surgery **16**:569, 1944.

On June 1, 1944, the senior orthopedic consultant became Chief of the Surgical Branch in the Professional Division, Office of the Air Surgeon, which position he occupied until Oct. 15, 1945. While in this position, he continued, in addition to his other duties, to direct the activities of the orthopedic services.

In August 1945, a committee of three orthopedic surgeons, Major James V. Luck, Chanute Field, Ill. (chairman), Major Hugh M. A. Smith, of Santa Ana Army Air Base, Calif., and Lieutenant Colonel Henry B. Lacey, Hammer Field, Calif., was appointed by the Surgical Branch to collect data for the Army Air Forces orthopedic history. It was decided that only statistics on selected subjects would be obtained from fourteen of the largest and most active orthopedic services, in charge of which there had been a well trained orthopedic surgeon during nearly the whole period of the war. These hospitals were as follows: Santa Ana and Hammer Fields, Calif.; Buckley Field, Colo.; Lincoln, Neb.; San Antonio Aviation Cadet Center and Sheppard Field, Texas; Chanute Field, Ill.; Mitchell Field, N. Y.; Langley Field, Va.; Keesler Field, Miss.; Maxwell Field, Ala.; Hunter Field, Ga., and Drew Field and Coral Gables, Fla. This committee first met in September 1945 to discuss the subjects to be investigated and to agree on a uniform method of recording and evaluating statistics; the committee then spent several weeks in visiting these hospitals to collect statistics, at which visits histories and roentgenograms were reviewed, available patients examined and discussions of the cases had with the chief of the orthopedic service. The committee met a second time, in January 1946, to review the accumulated data and decide on the type of report to present. One thousand, six hundred and forty-nine case studies with roentgenograms were selected for the final report, which was then written by Major Luck.

As operative treatment of the knee and shoulder had been the most frequently performed surgery in the Army Air Forces hospitals, it was agreed that all possible information should be obtained on these two subjects. Ununited fractures of the scaphoid had been repeatedly operated on with discouraging results, so that statistics on these were collected. The psychologic problems had been important, and the necessity for good rehabilitation had constantly been emphasized during the whole war period; hence, sections are devoted to these. The previous publications [3] of the senior orthopedic consultant had included discussions of the bad back and the painful foot; hence, these two problems, which constituted such a large part of all military orthopedics, are omitted. There were definitely no orthopedic problems encountered which might be considered peculiar to or the result of flying. The Army Air Forces hospitals received few battle casualties, and the Army Air Forces

3. Shands (footnotes 1 and 2).

maintained no hospitals overseas; hence, this report is concerned mainly with the orthopedic problems encountered in the flying and ground personnel being trained for overseas duty in combat units and in the flying and ground personnel remaining in the Continental United States in permanent assignments.

It is appreciated by us that for many reasons this historical record is in no way complete. This is to be regretted. However, it is believed that in the years to come the physician desiring information on the orthopedic surgery of the Army Air Forces in World War II will be able to obtain from this history and the two publications of the senior orthopedic consultant a good insight into the problems which the orthopedists faced from 1942 through 1945 in the Army Air Forces hospitals in the Continental United States.

The following list is of the sections, with the number of cases in each section, presented in this report:

A. Internal Derangements of the knee		1,411 cases
1. Menisectomy	1,132 cases	
2. Loose bodies	186 cases	
3. Ruptured ligaments, their surgical treatment	32 cases	
4. Chondromalacia of the patella	61 cases	
B. Recurrent dislocation of the shoulder		175 cases
C. Ununited fractures of the carpal scaphoid		63 cases
D. Psychologic problems		
E. Convalescent care and rehabilitation		

A. INTERNAL DERANGEMENTS OF THE KNEE

MENISCECTOMY

Meniscectomy was the operation most frequently performed on the knee joint, and in most Army Air Forces regional hospitals it was the most frequently performed major operation in the orthopedic section. Excluding minor sprains, lesions of the meniscuses were the particular lesions most frequently incurred by soldiers during the war. That such lesions deprived the Army of many trained soldiers is an obvious, though unfortunate, fact. The vast number of meniscuses removed during the war played a significant part in the evolution of our present ideas of the subject. We now have a clearer concept of: (1) lesions of the posterior one third of the meniscus, (2) the indications for operation, (3) postoperative synovitis, (4) convalescent care and (5) psychologic aspects of problems of the knee.

Various functions have been assigned to the meniscuses. They are said to form cushions to help check motion at the end of flexion and extension and partially to adapt the shape of the tibial plateau to the femoral condyles. Whatever the functions of the meniscuses, it is well established that the knee joint generally can carry on well without them.

Blood vessels lie at the periphery of the meniscuses, but supply little nourishment. The central two thirds of the meniscuses, having neither blood vessels nor lymphatic vessels, depend entirely on diffusion of synovial fluid for nourishment. Tears of the meniscuses, except for those at the periphery, have no capacity for repair. There is never any repair of longitudinal splits of meniscuses or of any other type of tear in the portion of the cartilage nourished by diffusion.

Etiologic Aspects.—The causes of injury of the meniscus are fairly well understood. Occasionally a bizarre type of tear is seen that cannot be readily explained, but since more than two thirds of all the lesions of the meniscuses represent some form of traumatic split, the majority of cases are readily explainable.

Approximately 50 per cent of the Army Air Forces cases of injury to meniscuses could be traced to sports, of which football, basketball,

TABLE 1.—*Causes of Lesions of the Meniscuses*

Intrinsic	Extrinsic
1. Constitutionally poor quality cartilage	1. Traumatic torsion of knee plus abduction or adduction during flexion
2. Poor knee mechanics a. Genu varum or valgum b. Genu recurvatum c. Shortening of one leg	2. Hyperflexion or hyperextension
3. Degenerative changes in the meniscuses	3. Muscle imbalance a. Atrophy and weakness of the quadriceps, particularly the vastus internus b. Paralysis of the quadriceps
4. Unstable ligamentous apparatus a. General relaxation b. Rupture of one or more ligaments	

track and baseball, in the order named, caused most injuries. About 20 per cent of the injuries were attributed to activity on obstacle courses and calisthenics, and 15 per cent more occurred spontaneously in walking, sleeping, stooping or kneeling.

Most of the causes of lesions of the meniscuses fell into two groups, intrinsic and extrinsic, as listed in table 1.

In the training installations, particularly the cadet training centers, a strenuous program of sports and difficult obstacle courses were an important part of the training program. Exercise in these programs was long and arduous and involved running, twisting, jumping, climbing and crawling. Added to this was the great number of knees with poor mechanical equipment for strenuous exercises, so that the inevitable result was a high incidence of the lesions of the meniscuses. Poor knee mechanics was attributed to three causes: First, there were many trainees who had never before engaged in strenuous exercise. These soldiers had muscular and ligamentous structures that were mechanically unadapted for obstacle courses and strenuous sports. A long build-up

period would have conditioned these knees, but time was too short for a carefully graduated conditioning program. A second factor was noted when a medical history was carefully taken. During the activities of high school or college sports, multiple so-called mild strains had been incurred, without episodes of true locking. It became increasingly apparent that lesions of the meniscuses are progressive. In the evolution of a split and interposition, there usually was a series of "minor" injuries which prepared the meniscus for the ultimate tear that came so often from the mildest trauma. Areas of degeneration in the meniscus, created by previous trauma, probably are related to the pattern and the ease of occurrence of the final lesion, which ordinarily was a longitudinal split. There was also evidence that previous injuries often created an increased mobility of the meniscus, making it more susceptible to becoming impinged between the condyles of the tibia and the femur. A third factor was in congenital malconstruction of the knee. Knees were not all of the same quality. Some were too loose; some were too tight; some were poorly aligned, and others had poor contour. This is not intended as a quarrel with nature, but merely to point out that from a mechanical standpoint some knees were congenitally poor. When these weak knees were subjected to the physical stresses that go with full military duty, it was no surprise that they proved unequal to the task.

Throughout the war, more than half (54.7 per cent) of the patients whose knees were operated on for lesions of the meniscuses had a history of previous episodes of symptoms referable to injuries to the meniscuses. Many of the patients had had a long period of conservative treatment when it was surgical treatment that they needed. Frequently a physician had never been consulted. Other patients had had repeated manipulations, usually by an osteopath or chiropractor. Since a high proportion of soldiers had come from small towns and farms, only seldom had an orthopedic surgeon been consulted.

With enforced immobilization after previous injuries, many patients had experienced atrophy of the quadriceps and had never taken measures to correct it. In these patients strenuous exercises soon led to strains, sprains and synovial effusion. Sooner or later the lesion of the meniscus locked the joint. There was a tendency to underestimate the role played by the quadriceps in protecting the knee from excessive torsion. Bristow,[4] in emphasizing this point, stated, "In fact, there is no mechanism other than the quadriceps which prevents rotation until the knee is locked in full extension." A quadriceps which was inadequate to give the knee the protection it should have, proved to be high on the list of causes of internal derangements.

4. Bristow, W. R .: Internal Derangements of the Knee, J. Bone & Joint Surg. **7**:413, 1925; **17**:605, 1935.

Subjective Symptoms.—It was necessary to insist on corroborative objective observations, regardless of a convincing history. During the war there were numerous instances in which psychosomatic symptoms were focused on the knee joint and resembled the subjective symptoms of an internal derangement. Several such "psychogenic knees" were explored surgically, which only fixed and aggravated the symptoms. Patients with recurring episodes learned to unlock their knees quickly by various maneuvers before spasm of the muscles became well established.

When a patient was asked whether or not his knee had ever locked, the meaning of the term "locking" was clearly described to him. There was a variety of pictures that patients visualized as representing a locked joint when the term was not explained.

Since the presence or absence of the locking symptom was such a conspicuous part of the history of the derangement of the meniscus, it appeared worth while to classify the various meniscus syndromes on the following basis:

1. Syndromes of the meniscus associated with locking:
   (*a*) A history of numerous or few recurrences of locking and unlocking, severe with the first episode, but with diminishing synovial reactions in succeeding episodes. A complete bucket handle type tear frequently created such a history.
   (*b*) Progression to locking in which true locking does not occur during the first episodes, but does occur eventually. The final true locking in these cases may be associated with such simple movements as pivoting, squatting, kneeling or turning in bed.
   Progression to locking probably arises in most cases when the tear at the outset is inadequate to permit a lasting interposition between the condyles. In time the split lengthens and then becomes capable of causing a true locking.
2. Syndromes of the meniscus not associated with locking:
   (*a*) A history of numerous episodes of "giving way" or of snaps, clicks, clunks, catches and jerks. Each episode is associated with a brief period of disability and increased synovial fluid. Flaps or pedunculated lobes of meniscus tissue may quickly snap in and out between the tibial and femoral condyles. A detached anterior or posterior pole can also cause episodes of this type. The so-called hypermobile meniscus has a place in this group.
   (*b*) Recurrent episodes of pain and swelling of the knee associated with anterior tenderness of the joint, but no true locking and no snapping or other momentary symptoms of the joint. Excessive activity frequently precipitates an episode of symptoms. The diagnosis is obscure and difficult in these cases, and the operation is often scheduled as an exploration. A variety of the lesions of the meniscus have been seen in this group, including bucket handle tears in which the handle had been in the intercondylar notch for many weeks or months. In these cases the tear was so complete that no limitation of extension existed.

Objective Observations.—Increased Synovial Fluid: Increased synovial fluid was a consistent observation, but was only slight when there were recurrent episodes over a protracted period. When the increased synovial fluid was slight, it was more easily palpated at the medial aspect of the joint than in the suprapatellar pouch. Thickening and edema of the synovial membrane was not an uncommon observation when there was hemorrhage into the joint or associated traumatic synovitis.

In examining for locking, a comparison should always be made with the opposite knee. A limitation of only 5 degrees had significance, but was readily missed in a superficial examination. This was particularly true in persons who had physiologic hyperextension.

While most tears of the cartilage with an interposed segment did not limit extension more than 5 to 20 degrees, there was an occasional

posterior half-split that interposed and blocked the joint from its last 40 to 60 degrees of extension. In one instance the knee suddenly locked and would not extend beyond 120 degrees. A medial menisectomy had been done several years previously, through the usual anterior approach. Pronounced tenderness was present at the posteromedial aspect of the joint. Roentgenograms revealed no abnormalities and manipulation without anesthesia was not helpful, so that an arthrotomy was done. The posterior half of the medial meniscus, which had not been removed during the previous partial meniscectomy, had split and was locking the joint. A second posteromedial incision was made and the posterior half of the meniscus excised.

Palpation: Palpation of the suspected meniscus during movements of the joint frequently netted useful information. When the meniscus would snap in and out between the condyles, it was readily palpable. When this happened in the posterior half of the meniscus, it was recorded as a positive McMurray sign. The anterior half snaps near the end of extension and the posterior half near the end of flexion.

The McMurray[5] Sign: With the patient in the supine position, the knee is fully flexed. After a palpating finger has been placed firmly over the posterior half of the meniscus being tested, the knee is placed in abduction and external rotation and then slowly extended. The same technic is carried out with the knee in internal rotation and adduction. The maneuver may be changed to merely rocking into internal and external rotation during full flexion or moving the knee into the last few degrees of flexion with internal or external rotation and abduction or adduction. A firm clearcut snap is felt with the examining finger when the result of the test is positive. The snap frequently is audible even without a stethoscope. While the test was by no means pathognomonic, it was useful and was included in the routine examination of knees. When the results were positive, it was not considered to mean that the lesion was limited to the posterior third of the meniscus. Bucket handle tears occasionally yielded a positive result to a test. Slocum and Moore observed fifteen positive reactions in a series of one hundred and twelve McMurray tests of the meniscus.

Atrophy of the Quadriceps: Atrophy of the quadriceps, with its associated weakness, stood out as one of the most important of the objective observations. Measurements of the thighs were believed important and were accurately conducted and carefully recorded. Test for strength of the quadriceps included deep knee bends, when feasible, since manual tests of the quadriceps were not accurate in strong muscular persons.

5. McMurray, T. P.: The Diagnosis of Internal Derangements of the Knee, in Robert Jones Birthday Volume, London, Oxford University Press, 1928.

Atrophy of the quadriceps occurs so rapidly following injuries of the knee that many observers have expressed the belief that the phenomenon is more than an atrophy of disuse. Murray[6] stated, "It is not an atrophy of disuse; it is well marked by the fifth day after injury, and always by the tenth day. The nature of this curious phenomenon has never been accurately determined." A large element of atrophy from disuse did appear to take place in post-traumatic atrophy of the quadriceps. This was indicated by the sharp decrease in the degree of atrophy that was experienced when heavy resistance quadriceps exercises were instituted preoperatively and promptly postoperatively. In these exercises attention was focused on resisted quadriceps contractions and not on joint motions. Details of the exercise program are given in the section on "Convalescent Care."

Instability: Instability of the knee occasionally played an important role in syndromes of the meniscus so that when instability was present care was taken to identify it during the physical examination. Many surgeons, in dealing with muscular persons, observed previously undetected instability when the patient was given an anesthetic.

Instability of the knee made the meniscus more vulnerable to injury. In many instances a torn medial meniscus was incurred simultaneously with a ruptured tibiocollateral or anterior cruciate ligament. The incidence of lesions of the meniscuses appeared to be higher in loose-jointed persons than in those with tight joints, but no statistics are available on this point.

Crepitus, Clicks, Clunks and Catches: Crepitus, clicks, clunks and catches occurred frequently in internal derangements of the knee. In young adults, torn meniscuses headed the list of the direct and indirect causes. Crepitus generally was due to associated degenerative changes in the articular cartilages. Clicks and clunks most frequently were due to interposed bodies, of which flaps or "handles" of meniscuses are the commonest. Catches were due to lesions of the meniscus, but also were caused by defects in the articular surfaces of the tibia, femur or patella. Instability of a knee often was responsible for catches through momentary subluxations during joint motion.

Roentgenograms: Roentgenograms helped to evaluate objective obstructions. So-called ligament stretch roentgenograms were used by several orthopedists to record the degree of instability accruing from lost integrity of a given ligament. This was accomplished in the case of the tibiocollateral ligament by taking the roentgenogram while the knee was in forced abduction and slight flexion. For the anterior crucial ligament, the knee was flexed 90 degrees and the tibial plateau forced forward. The tibia was forced backward to evaluate stability in the

6. Murray, C. R.: Complicating Factors in the Treatment of Injuries to the Menisci of the Knee Joint, Am. J. Surg. **55**:262, 1942.

posterior crucial ligament. Injections with air were seldom employed in the A. A. F. hospitals because their interpretation was difficult and uncertain. A few orthopedists,[7] however, expressed the opinion that they gained sufficient information to justify the procedure.

Psychogenic Symptoms.—During the war the knee joint was repeatedly discovered to be the focus of psychogenic symptoms. Psychogenic symptoms of the knee represented: (1) a perpetuation of symptoms from a healed organic lesion, (2) an exaggeration of existing organic symptoms or (3) a conversion hysteria without an associated organic lesion either in the present or past.

A psychologic history, at least in the abbreviated form, was taken whenever symptoms of the knee were bizarre and out of proportion to the physical observations. The physical examination often included a check for the presence of hysterical sensory changes (circumferential hypalgesia).

Mental Stability: It was learned by bitter experience that the mental stability of the patient should be evaluated and found satisfactory prior to elective surgical treatment of the knee. Willien [8] stressed this point when he stated, "The emotional stability and personality of the patient are as important as the knee pathology in considering the treatment or disposition." When a knee was so securely locked that it would not respond to gentle or moderate manipulation, there was no choice but surgical intervention. However, in the vast majority of instances the operation was deferred when either mental instability or a frank psychoneurosis was present. Since it was not possible in many installations to send all patients considered for elective surgical treatment to the psychiatrist for evaluation, most medical officers learned to do their own evaluations. In many instances soldiers needed considerable superficial psychotherapy preoperatively, particularly reassurance. Many psychologic problems were prevented by the proper mental preparation of the patient for surgical treatment. Undue apprehension preoperatively had many explanations. Often a soldier had previously been advised to "never let a surgeon stick a knife in his knee." Unfortunately, such advice all too frequently had come from an uninformed physician.

Superficial psychotherapy was needed postoperatively in many instances. Psychologic problems occasionally developed during convalescence. Proper reassurance and the prevention of "morbid preoccupation" during convalescence did much to prevent psychologic complications. That the prevention of psychologic complications was

7. McGaw, W. H., and Weckesser, E. C.: Pneumograms of the Knee, J. Bone & Joint Surg. **27**:432, 1945.

8. Willien, L. J.: Second Year End-Results of Arthotomies of the Knee, Bull. U. S. Army M. Dept. **4**:452, 1945.

worthy of the effort required was emphasized by the cases in which knee disability was perpetuated for months or years on a psychogenic basis. The secondary gain to the patient from illness proved to be a powerful force and had to be counteracted in emotionally unstable persons by vigilant reassurance and a firm hold on the patient's confidence. When prevention failed, every effort was made to detect and correct psychogenic symptoms in their incipiency. Once such symptoms became well established, the problem became magnified tremendously. When such symptoms became fixed, cure generally was impossible. Prevention proved to be the brightest ray of hope for effectively dealing with this important aspect of the problems of the knee in the military.

Specific Psychogenic Symptoms of the Knee: Specific psychogenic symptoms of the knee that were observed in relation to suspected lesions of the meniscus are: (1) "giving way"—this was a favorite neurotic symptom of the knee; rarely did the patient fall or injure himself, and there were no associated objective observations of the muscle or the knee joint; (2) hysterical fixed extension—the patient walked with the knee rigidly extended, presenting what was described by a psychiatrist as a "ceremonial gait"; full flexion was possible whenever the patient was not walking; (3) hysterical flexion—the patient walked with the knee in partial flexion, resembling the hysterically flexed spine of camptocormia—and (4) exaggeration of existing organic symptoms—this frequently was confusing when symptoms from a lesion of the meniscus were known to exist; only a broad background of experience proved to be a satisfactory basis for estimating where the organic aspect ended and the psychogenic aspect began. An anxiety or tension state frequently was found responsible for the magnified symptoms. A long cutaneous scar tended to cause more psychogenic magnification than a short scar.

When a knee joint was a focus of neurotic symptoms, the following observation was often made. As the knee was passivley flexed, resistance was encountered after a few degrees and the patient would contend that the joint could not move farther. However, with firm, steady pressure the joint would move slowly and jerkily through a normal range of flexion and extension. This observation was in striking contrast to the condition observed when a knee joint was limited in flexion by an organic lesion. When substantial resistance and pain are met in the process of passively flexing the knee with an organic condition, there is progressively increasing muscle spasm and seldom can the patient tolerate more than a few additional degrees of flexion.

Early in the war, elective operations were done to remove meniscuses in which there were long-standing lesions, in order to qualify soldiers for full military duty. This procedure failed in a high percentage of cases because of complicating factors, which included: (1) diffuse degenerative changes in the knee joint not seen in a roentgenogram,

(2) chronic synovitis, aggravated by strenuous activities, (3) associated chondromalacia of the patella, (4) associated ligamentous instability, (5) psychosomatic overlay and (6) the impossibility in many instances of temporarily limiting rigorous activities. On account of this situation in the early days of the war there was then a period in which most soldiers with episodes of internal derangement of the knee due to lesions existing prior to military service were reclassified to limited duty, without surgical treatment. Few soldiers were given a certificate of disability discharge (C. D. D.), since a War Department directive, issued early in the war, stated, "No soldier will be discharged from the service from whom any useful service can be obtained."

In general, it can be said that the treatment of lesions of the meniscus was more radical when the lesion was incurred in the line of duty (L. O. D.) and more conservative when the lesion existed prior to service (E. P. T. S.) than is the case in most civilian orthopedic practices. Civilian orthopedists frequently take a conservative attitude toward meniscectomy. MacAusland [9] recommended surgical treatment only in recurrent cases when the locking cannot be reduced. Murray [6] stated, "Only those cases which evidence locking of the joint, and in which locking cannot be reduced under an anesthetic, are urged to undergo primary operation." The reasons for recommending surgical treatment in the line of duty cases include: (1) Once a meniscus is split it does not heal, and, if strenuous duties are engaged in, more episodes of disability can be expected, often at such inopportune occasions as during battle; (2) injuries to knees of soldiers that tear meniscuses are generally severe injuries that require a rather long period of hospitalization, even without surgical treatment, and (3) when a knee was permitted to become locked several times prior to surgical intervention the chances for complete rehabilitation of the soldier diminished. Reasons for this were both physical and mental. In this survey of 1,132 patients who underwent meniscectomy, 214 patients, or 18.8 per cent, were operated on after the first episode and 620, or 54.7 per cent, had a series of a few to many episodes prior to surgical treatment. Many of these latter patients had lesions existing prior to service and were operated on early in the war for the purpose of rehabilitation or later in the war because of locking. Of the 1,132 patients, 712 or 62.8 per cent had lesions incurred in line of duty and 420, or 37.2 per cent, had lesions which had existed prior to service.

Operation was seldom done immediately after the patient was admitted to the hospital. At least a brief period of conservative treatment was employed, which included hot or cold packs and frequently skin traction. This gave an opportunity to evaluate the observations.

9. MacAusland, W. R.: A Study of Derangement of Semilunar Cartilages Based on Eight Hundred Fifty Cases, Surg., Gynec. & Obst. **77**:141, 1943.

At the outset of a severe injury to the knee the swelling and muscle spasm frequently make it difficult or impossible to identfy the status of any specific structure.

Progression to locking occurred in 270 patients, or 23.8 per cent of the series. This group presented nonlocking episodes on several occasions followed ultimately by an episode of true locking. The episode of locking clarified the diagnosis in many previously obscure cases. If it were not for the damage done to the joint by the repeated nonlocking episodes, it might be wise to await an episode of locking whenever the diagnosis is not clearcut. But severe damage to the joint is inflicted in many instances, and often there are repeated costly periods of disability. The reason that cases in this group are numerous is that, when lesions existed prior to service, operation was deferred until it was made imperative by an episode of locking.

Age was not often a factor in making the decision regarding the type of treatment indicated. Persons of older age were obviously not seen in the service, the average age of the patients in this series being 24.7 years.

Operative Technic.—That surgeons in the service were divided on the question of partial versus total excision of meniscuses is reflected in the technic employed in the 1,132 cases of this study; one capsular incision was used in 667, or 59 per cent, and two capsular incisions were used in 465, or 41 per cent. There is no question that the use of two capsular incisions gained considerable ground during the war. Impetus to the use of the combined approach came from: (1) better understanding of the posterior approach; the Bosworth [10] and the Cave [11] incisions were widely used, as was also the technic of two separate short incisions; (2) recognition that incidence of posterior lesions is higher than was formerly recognized, and (3) the necessity for using a technic in soldiers that would be followed by a minimum of residual symptoms.

Bristow [4] pointed out, "With few exceptions, and these in a lax type of knee, the whole cartilage cannot be removed via the anterior route, unless the entire internal lateral ligament or a part of it is cut." Bristow [4] recommended that the cartilage be dissected free in its anterior half and then pulled on. He stated the belief that if a posterior lesion exists the meniscus can be drawn into the intercondylar notch and cut off. When the meniscus did not dislocate into the notch, it was taken to indicate that no significant posterior lesion

10. Bosworth, D. M.: An Operation for Meniscectomy of the Knee, J. Bone & Joint Surg. **19**:113, 1937.

11. Cave, E. F.: Combined Anterior-Posterior Approach to the Knee Joint, J. Bone & Joint Surg. **17**:427, 1935.

existed. Slocum and Moore [12] insisted that this is not a dependable method, there being many posterior lesions that cannot thus be visualized.

Slocum and Moore [12] urged that the entire cartilage be removed routinely in all cases. In their report of one hundred and twelve meniscectomies at Letterman General Hospital, eighty-one were total excisions. In 22 of their cases, there were localized posterior lesions consisting of ten posterior bucket handle tears, five posterior angle tears, six avulsions of the posterior third and one posterior horn tear associated with an anterior horn tear. They considered total excision mandatory (1) in the presence of these localized posterior lesions, (2) in the presence of bucket handle tears of the middle third, (3) in lesions of the posterior third in cases in which there was reoperation and (4) when avulsions are complete except for anterior and posterior attachments.

Mintz [13] contended, "Once a joint has been opened for a meniscus injury, the entire cartilage should be removed whether the injury can or cannot be seen." This contention is based on the observation of a considerable number of posterior lesions that could not be identified until the posterior third of the meniscus was visualized.

There was a fairly large group of army surgeons who excised only the split-off portion of torn mensicuses. The anterior end of the "bucket handle" was severed, and, if the handle was not already in the intercondylar notch, traction and manipulation were employed to bring it into the notch, after which the posterior end was severed. The periphery of the cartilage was left in place, on the basis that it rarely does harm and may serve a useful purpose. Operating time and effort were shortened, and convalescence was more rapid. Childress and Hagen [14] and Terhune, Eddleman and Read [15] expressed the belief that only rarely does a patient operated on with this technic require a second operation because of derangement from lesions of the unresected periphery. Since there was a small number of patients requiring reoperation, routine total excision was not believed to be justifiable. It must be said, in this regard, that while the number of patients who required reoperation was relatively small, it was greater than is generally realized. There were undoubtedly other patients who did not have a second arthrotomy, but who were constantly disabled from unvisualized and unexcised lesions of the peripheral portion of the cartilage.

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12. Slocum, D., and Moore, D. E.: Posterior Horn Lesions in Meniscal Injury, Surg., Gynec. & Obst. **77**:87, 1943.

13. Mintz, B. J.: Internal Derangements of the Knee, Am. J. Surg. **70**:189, 1945.

14. Childress, H. M., and Hagen, W. H.: Practical Aspects of the Diagnosis and Surgical Treatment of Meniscus Injuries, Mil. Surgeon **93**:301, 1943.

15. Terhune, S. R.; Eddleman, T. S., and Read, B. S.: Care of the Knee Following Excision of a Meniscus, J. Bone & Joint Surg. **26**:663, 1943.

When it is possible, the patellar branch of the internal saphenous nerve should not be severed. This nerve was severed many times in the series herein reviewed, but only rarely did a neuroma develop and cause disability.

In the closure of the capsule after a meniscectomy which was observed to be associated with relaxation or rupture of the anterior crucial ligament, imbrication of the capsule anteriorly appeared to be worth while, as a means of contributing to the stability of the knee.

While nearly all surgeons used a tourniquet, there were a few men who did not, in the belief that the incidence of postoperative hemarthrosis was lower and recovery more rapid.

In closing the operative wound, there was wide variation in closure of the synovia. Some surgeons followed the teaching of Murray [6] and did not close the synovia; others did only a partial closure, the purpose being to allow excessive synovial fluid to exude into neighboring soft tissue.

TABLE 2.—*Lesions of the Meniscuses*

Type or Absence of Lesions	Number of Cases	Percentage of Cases
Lesions of the anterior third	223	19.7
Bucket handle tears	507	43.9
Lesions of the posterior third	123	10.9
Hypermobile meniscuses	101	8.9
Transverse tears	64	5.6
Cysts (lateral)	55	4.8
Cysts (medial)	4	0.35
No lesions observed	55	4.8
Total	1,132	100.0

Lesions of the Meniscuses.—The incidence of the various lesions of the meniscuses in this series of 1,132 cases is recorded in table 2.

The ratio of lateral to medial lesions of the meniscuses was 1 to 5.1. These statistics will be compared with those of several other reports.

In 1909 Sir Robert Jones [16] reported the following incidence of 104 commoner lesions of the meniscuses in a series of 117 cases (quoted by Timbrell Fisher [17]):

Torn anterior attachment	53
Longitudinal splits	16
Transverse fractures opposite the ligament	12
Loosely bound circumferentially (hypermobile)	8
Loose anterior with nodular changes	8
Displaced posterior horn	7
Total	104

16. Jones, R.: Notes on Derangements of the Knee (Based on Personal Experience in Over Five Hundred Operations), Ann. Surg. **1**:969, 1909.

17. Fisher, A. G. T.: Internal Derangements of the Knee Joint, ed. 2, New York, The Macmillan Company, 1933.

Of the lesions in the cases reported by Fisher,[17] 27.8 per cent were lesions of the anterior third, 13.93 per cent were lesions of the posterior third and 47.54 per cent were bucket handle tears.

Bristow [4] observed that in his study of six hundred and twenty-nine torn meniscuses, 31 per cent were in the posterior part of the cartilage.

Dunn,[18] in a study of one hundred and thirty-nine medial and thirty lateral lesions of the meniscuses, observed that the lesions of the medial meniscuses occurred as follows:

Detachment or fracture of the anterior half	19
Detachment or fracture of the posterior half	64
Bucket handle tears	35
No definite lesion	21
Total	139

Of the forty-six external lesions of the meniscuses in the series reported by Dunn, twenty-one were in the posterior half. Thus, it can be seen that the lesions of the posterior half of meniscuses must occupy an important place in the consideration of operative technic.

Hypermobility of Meniscuses: The "loose meniscus" has been a subject of much discussion for a long time. Opinions as to its importance vary from a denial of its existence as a true lesion (Cleveland, Willien and Doran [19]) to MacAusland's [9] statement in his series of 850 cases that it is second in frequency to fractures of the meniscus. It has been contended that hypermobility would have to represent unhealed ruptures of coronary ligaments, and this is said not to happen, since coronary ligaments heal when injured. But the majority of the Army Air Forces surgeons interviewed for this report insisted that hypermobility does exist as a definite pathologic state and can result in interposition with episodes of derangement. It was the consensus that hypermobility in many cases ultimately terminates in longitudinal tears because of interposition between the tibial and femoral condyles from the increased mobility. Unfortunately, there have been instances in which the diagnosis of hypermobility and hyperplasia of the fat pad have been resorted to whenever a normal knee was encountered at operation.

Degeneration in meniscuses was observed many times. There is evidence that degeneration following trauma or impaired nutrition for other causes makes the meniscus more susceptible to tears. Ceelen [20] studied two hundred postmortem specimens and two hundred and seventy surgical specimens and observed degenerative changes in 40

18. Dunn, N.: Diagnosis and Treatment of Common Injuries of the Knee Joint, Brit. M. J. **2**:639, 1931.

19. Cleveland, M.; Willien, L. J., and Doran, P. C.: Surgical Treatment of Internal Derangements of the Knee Joint Among Troops in Training at Ft. Jackson, South Carolina: End-Result Study, J. Bone & Joint Surg. **26**:329, 1944.

20. Ceelen, W.: Pathology of Meniscus Lesions, Arch. f. orthop. u. Unfall-Chir. **37**:334, 1937.

per cent. He stated that in Germany it was proposed that no compensation be given a worker if his excised meniscus showed degeneration and the tear had occurred through a minor trauma. Tear of a healthy meniscus requires a strong force.

Cysts of Meniscuses: Cysts of meniscuses were encountered in 59 cases, and, as would be expected, in 55 the lesions were laterally situated. Total excisions of meniscuses with cysts were done, as has long been recommended, to prevent recurrences. This series of cysts casts no light on whether such cysts represent a degenerative or a neoplastic process.

Associated Pathologic Conditions.—The associated pathologic conditions encountered in the 1,132 cases herein reviewed are shown in table 3.

There was considerable variation in attitude toward edematous hyperplastic fat pads associated with lesions of the meniscus, but the practice of dealing with the fat pad with a heavy hand was not popular.

TABLE 3.—*Associated Pathologic Conditions*

Pathologic Condition	Number of Cases	Percentage of Cases
Interposed and hyperplastic fat pad	66	5.8
Rupture of a crucial or a lateral ligament	49	4.3
Degenerative arthritis (diffuse)	46	4.0
Chondromalacia of the patella and femur (localized)	44	3.9
Osteochondritis dissecans	27	2.4
Loose bodies (unknown source)	25	2.2
Total	257	22.6

Most surgeons limited their excision of fat pad substance to parts that had been impinged, as indicated by fibrosis, ischemia or necrosis.

Rupture of a crucial or lateral ligament, when seen in association with a lesion of the meniscus, was not repaired at the time of the meniscectomy. Occasionally a flap of a severed anterior crucial ligament was observed to be interposed between the joint surfaces; such flaps were excised.

Degenerative arthritis, at least in a localized form, was seen in many of the cases in which there was a protracted history of repeated episodes. There appeared to be no question that repeated derangements of a meniscus lead to degenerative changes in the articular cartilage of the knee joint. Smith and King [21] reported 10 cases in which lesions of the medial aspect of the meniscus were associated with localized degeneration of the articular cartilage of the medial aspect of the femoral condyle opposite the lesion of the meniscus. The end results in these cases were good and did not appear to be influenced by the area of

21. Smith, A. D., and King, B. B.: Injury of the Femoral Articular Cartilage by the Medial Meniscus, Surg., Gynec. & Obst. **71**:679, 1940.

chondromalacia. Caldwell,[22] at Camp Livingston, La., noted degenerative changes in the medial aspect of the femoral condyle associated with lesions of the medial aspect of the meniscus in sixty-nine of eighty-three meniscectomies (67.6 per cent). His record showed that the degenerative changes of the articular cartilage were in direct proportion to the duration of the internal derangement and were not due to the character of the original trauma. However, if the original trauma also causes ligamentous relaxation or rupture along with the lesion of the meniscus, degenerative changes usually occurred more rapidly and more extensively. Caldwell [22] mentioned the point that during an arthrotomy, when he saw a normal-appearing meniscus associated with an area of degeneration in the femoral articular surface opposite the meniscus, he routinely removed the entire meniscus and invariably observed a lesion of the posterior third.

In experiments with dogs, King [23] demonstrated areas of degeneration in the articular cartilage of the knee following meniscectomy and concluded that loss of the meniscus could result in degenerative changes.

Degenerative changes in the articular cartilage may be well advanced and developed, yet nothing whatever appears in the roentgenograms to indicate the presence of the changes. On many occasions opening of the knee joint revealed a surprising extent of degeneration of cartilage. In other cases, degenerative arthritis was no surprise, its existence having been foretold by the crepitus, the marginal osteophytes, the narrowed cartilage space and subchondral osteosclerosis. Excision of a definitely deranged meniscus was not believed to be contraindicated because of the presence of degenerative arthritis. What was believed to be contraindicated was the performance of arthrotomy of a degenerative arthritic knee as a result of misinterpretation of arthritic symptoms as symptoms of a torn meniscus.

Chondromalacia of the patella and the femur was repeatedly observed, and on a number of occasions arthrotomy was done for a suspected lesion of the meniscus when the symptoms were in reality due to chondromalacia. Coning and shaving the localized areas of malacia was more popular at the beginning of the war than at the end. In not a few cases symptoms were aggravated following the coning and shaving. A discussion of this subject has been reported by Soto-Hall.[24]

Associated osteochondritis dissecans was observed twenty-seven times in the 1,132 cases. When the osseocartilaginous body was still in its

22. Caldwell, G. D.: Internal Derangement of the Knee, Mil. Surgeon **92**: 648, 1943.

23. King, D.: The Function of the Semilunar Cartilages, J. Bone & Joint Surg. **18**:1069, 1936.

24. Soto-Hall, R.: Traumatic Degeneration of the Articular Cartilage of the Patella, J. Bone & Joint Surg. **27**:426, 1945.

bed, it generally was removed. When the dissecans body was free in the joint, it was searched out (having been identified in roentgenograms) and removed.

Loose joint bodies of unknown origin were observed in 25 cases. Since it is impossible to see much of the articular cartilage at an arthrotomy, it is relatively easy to overlook the healed over bed of origin of a loose body. Some of the loose bodies probably represented fractured off marginal osteophytes, and others represented fragments of articular cartilage fractured off the margins of the tibial and femoral condyles.

Complications.—The complications following meniscectomy in the 1,132 cases of this report are listed in table 4.

Of the 5 cases in which there was postoperative pyogenic infection, in 2 it was moderately severe and did permanent damage to the joint and in 3 it was a low grade infection, which healed without gross evidence of impairment of the joint.

TABLE 4.—*Complications Following Meniscectomy*

Complication	Number of Cases	Percentage of Cases
Postoperative infection	5	0.44
Hemarthrosis	59	5.2
Thrombophlebitis	3	0.26
Tourniquet paralysis	9	0.79
Synovitis (chronic)	14	1.2
Pulmonary embolus	1	0.088
Hysteria	22	1.9
Pneumonia	1	0.088
Total	114	9.906

Postoperative hemarthrosis of a significant character occurred in only 59 cases. There was general agreement that knee joints distended with blood should be aspirated. In a few cases several aspirations were necessary, in spite of compression bandages. Whenever blood was permitted to distend the joint for several days, the period of convalescence was decidedly lengthened. At the end of the war, aspirations, when indicated, were being done more promptly and more frequently than in the beginning of the war.

As has been mentioned, a few surgeons abandoned the use of the tourniquet to reduce the incidence of postoperative hemarthrosis. Others removed the tourniquet prior to closing the operative wound. Less hemorrhage occurred when the operator resisted the temptation to cut off normal folds of the fat pad.

Thrombophlebitis was severe in 1 case and mild in 2. All of the patients with tourniquet paralysis recovered.

Postoperative chronic synovitis of a mild type, with a relatively brief course, occurred rather frequently, but caused no lasting trouble.

It was generally attributed to a weak quadriceps, too early and too much knee motion and too early weight bearing. A few soldiers, particularly aviation cadets, were eager to return to their training and, in their intense efforts to hasten recovery, created synovitis. The disease in the 14 cases of chronic synovitis, recorded as a complication, was of the persistent type of synovitis that did not readily yield to treatment. Factors other than surgical treatment entered into the causation of this form of synovitis. This was indicated by the occasionally increased rate of sedimentation, the slightly clouded synovial fluid and the increased local temperature of the involved knee. However, no organisms could be cultured from the synovial fluid in a single instance.

The most satisfactory of the many forms of treatment used for chronic synovitis was the combination of penicillin and typhoid vaccine employed by one of us (H. M. A. S.) at Maxwell Field, Ala. Penicillin was given intramuscularly every three hours for seven to ten days in doses of 30,000 units. Intravenous injections of typhoid vaccine, in sufficient quantity to produce a substantial chill, were given every other day, starting one day after institution of treatment with penicillin. Three to five injections were usually given.

The complication of pulmonary embolus, which occurred in 1 case, was associated with thrombophlebitis. After a stormy course the patient recovered.

Hysteria occurring in cases in which the knee was involved has been discussed. An acute anxiety state occurred postoperatively in 2 patients and required their transfer to a psychiatric section. The pneumonia was not severe in the 1 case in which it occurred and was believed to be related to the anesthetic.

Convalescent Care.—The convalescent care of patients who underwent meniscectomy improved during the war. One of the several reasons for the improvement resides in the fact that over and over again the tremendous importance of preventing atrophy of the quadriceps, when possible, and promptly correcting it when it occurred was "driven home." A powerful well coordinated quadriceps mechanism is important to every one, but it is indispensable to a soldier.

Preoperatively, instructions were routinely given in quadriceps setting and straight leg lifting. When the quadriceps was decidedly weakened by episodes of derangement of the knee, an attempt was made, when it could be tolerated by the knee, to build up the quadriceps prior to surgical treatment.

Quadriceps setting exercises were started the second postoperative day, straight leg raising the third day and carefully graduated flexion the fifth day. The knee was enveloped in a compression dressing, consisting principally of one or two elastic bandages. A cast or splint

was rarely used. Once straight leg raising could be negotiated with ease, weights were hung on the foot to give the quadriceps more force to contract against. Weights were attached to the foot in the form of a York boot, as recommended by De Lorme,[25] or merely through the use of a canvas bag with a strap. A saddlebag type of construction was also used. Only 1 or 2 pounds (about 0.5 or 0.9 Kg.) of lead balls or other forms of weights were used at the outset, but, as rapidly as tolerated, the weight was increased. It was not unusual for a soldier, at the end of convalescence, to be able to extend his knee with 100 pounds (about 45 Kg.) attached to his foot or hung over his ankle. Attention was given to the last few degrees of extension, in order to build a strong vastus internus, this muscle being the principal source of the last few degrees of extension of the knee.

Accurate records were kept of the thigh measurements during convalescence. At the end of a convalescence in which heavy resistance exercises had been properly employed, the thigh on the side on which operation had been performed was expected to be approximately equal in circumference to the opposite thigh. Soldiers who were given systematic heavy resistance exercises were in better condition to resume full military duty than soldiers who did not receive such exercises.

It proved convenient to divide convalescence into three stages (Luck[26]): (1) the power stage in which emphasis was placed on retaining and restoring quadriceps power, (2) the mobility stage, during which the emphasis was on restoring joint mobility, and (3) the coordination stage, during which emphasis was on restoring precise smooth function. Much of the power and mobility stages were carried out with the patient in his bed, whereas the exercises given during the coordination stage were carried out in a gymnasium.

The mobility stage was not started until quadriceps strength was good. When excessive emphasis was placed on movements of the knee while the quadriceps was weak, there was likely to be synovial trauma and increased synovial fluid. Too early weight bearing before the quadriceps was built up was another major cause of increase in synovial fluid. In the past, synovitis developing during convalescence usually was interpreted to mean that a further period of immobilization was needed. The principal need in such cases is for greater quadriceps strength. Therefore, heavy resistance quadriceps exercises were instituted, and they were given with the knee extended, no attempt being made to restore mobility until quadriceps strength was good. In general, when the muscles were properly cared for, the mobility of the joint took care of itself.

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25. De Lorme, T. L.: Restoration of Muscle Power by Heavy Resistance Exercises, J. Bone & Joint Surg. **27**:645, 1945.

26. Luck, J. V.: Orthopaedic Rehabilitation, Air Surgeon's Bull. **2**:431, 1945.

Weight bearing was not permitted for two to three weeks and frequently longer. Crutches, without weight bearing on the leg on which operation had been performed, were permitted after three to eight days.

Results.—Unfortunately, detailed long term studies of end results in the cases herein reviewed cannot be given. Hence, for this report, generalizations and, in many instances, impressions only can be presented.

A rather high percentage of the patients had to be given at least a temporary reclassification to limited duty, but there were relatively few certificate of disability discharges. Many soldiers returned to full duty and appeared to have no residual impairment of any kind. But even so, it appears unlikely that a knee joint, from an anatomic standpoint, can completely heal after severe injury and meniscectomy. The more rigorous the character of the soldier's assignment, the less likely he was to tolerate full duty. The percentage of soldiers returning to full duty after meniscectomy was lowest in the infantry, in which long marches over rough terrain were the rule. In Willien's [8] report of meniscectomies, only 26.4 per cent of the infantrymen returned to full duty.

Cleveland, Willien and Doran [19] reported seventy-five meniscectomies from Fort Jackson, S. C. At the end of the first year, 44.8 per cent of the patients were on full duty. At the end of the second year, Willien [8] reported that only 30 per cent of these patients were able to continue on full duty. He stated that commissioned and noncommissioned officers were twice as likely to remain on full duty as were privates and privates first class.

It should not be assumed that the 70 per cent of the aforementioned patients that were unfit for full duty had poor results. By civilian standards, a high percentage of these patients unquestionably had good results. The knee stresses incurred in the most strenuous civilian occupations cannot be compared to those sustained by a foot soldier in battle or on maneuvers. In the Army Air Forces the flying personnel was subjected to a rigorous ground training program that damaged a large number of meniscuses, as has been mentioned. But flying itself did not injure many knees. In most instances, air crewmen were able to return to full duty after meniscectomy, and this was particularly true of officers receiving flight pay.

In discussing the results specifically of meniscectomy, it is only fair to include the cases in which there was only an uncomplicated lesion of the meniscus. Often the cases in which the lesion was associated with a pathologic condition, such as ruptured ligaments, are not separated from the cases of uncomplicated lesions. This lowers the percentage of good results, and thus the meniscectomies may be unfairly criticized. Virtually all of the bad results following poorly performed meniscec-

tomies could be traced to an associated complicating lesion. The operation of meniscectomy itself is one of the most satisfactory procedures in orthopedic surgery, and nothing in the war experience of the Army Air Forces has changed this concept of the operation. This statement is made, of course, in the light of the knowledge that no joint ever completely heals after a severe injury.

Summary and Conclusions.—Rigorous military training routines injured many meniscuses because of the poor physical condition of some of the trainees. Time was too short for a carefully graduated build-up of muscle strength.

Regardless of a convincing history, surgical treatment was deferred when corroborative physical observations were not present.

Locking was the most conspicuous of the symptoms of a torn meniscus, but all lesions of the meniscus did not cause locking. There was immediate locking, progression to locking or no locking.

Of the objective observations, point or line tenderness and atrophy of the quadriceps were as important as locking.

The McMurray test was useful, though by no means pathognomonic of lesions of the posterior half of a meniscus.

Psychogenic symptoms of the knee represented the somatic manifestation of hysteria or an exaggeration of organic symptoms, usually as a result of an anxiety state. The emotional stability of the patient was estimated prior to elective surgical treatment of the knee. Neurotic reactions and a poor mental attitude were erroneously labeled psychoneuroses in many cases.

In general the treatment of lesions of the meniscus in the Army Air Forces tended toward being more radical in cases in which the lesion occurred in line of duty (L. O. D.) and more conservative in cases in which the lesion had existed prior to service (E. P. T. S.) than is true on the average in civilian orthopedic practice. The reasons for this have been presented.

Two capsular incisions were made in 41 per cent of the cases and the entire meniscus removed by direct vision. Lesions of the posterior third frequently could neither be visualized nor excised from an anterior approach to the knee joint.

"Bucket handle" tears were observed in 43.9 per cent of the excised meniscuses, and this was the commonest lesion. Hypermobility of meniscuses appeared to be a definite entity.

Significant hyperplasia and interposition of the fat pad occurred in 5.8 per cent of the patients in the series. Radical excision of the fat pad was rarely indicated. Degenerative arthritis was associated with lesions of the meniscus in 4.0 per cent of the patients in the series. Minimal changes were compatible with a good end result, but more advanced changes caused limited endurance and synovial effusion.

Associated lesions, such as localized or diffuse degenerative changes, osteochondritis dissecans, ruptured ligaments and chronic synovitis, were responsible for most of the bad results after meniscectomy.

Chronic persistent synovitis, complicating meniscectomy, was benefited most by treatment with a combination of penicillin and typhoid vaccine injected intravenously. Blood or synovial fluid, when distending a knee joint, was aspirated as frequently as necessary to prevent capsular tension.

A systematic program of heavy resistance quadriceps exercises was made a regular part of convalescent care.

Results from meniscectomy for uncomplicated lesions of the meniscus were good. The percentage of soldiers returning to full military duty after meniscectomy depended on their assignments, the percentage being higher for flying personnel than for ground personnel.

TABLE 5.—*Origin of Loose Bodies and Number and Percentage of Cases*

Origin	Number of Cases	Percentage of Cases
Osteochondritis dissecans		
a. Medial femoral condyle	76	40.8
b. Lateral femoral condyle	10	5.4
c. Patella	11	5.9
Trauma to articular surface of femur	6	3.2
Trauma to articular surface patella	15	8.1
Osteochondromatosis	3	1.6
Foreign bodies	2	1.1
Idiopathic	63	33.9
Total	186	100.0

LOOSE BODIES IN THE KNEE JOINT

Loose bodies were second only to meniscuses as a basis in Army Air Forces Regional Hospitals for the performance of arthrotomy of the knee joint.

More than half of the patients in this review had loose bodies in one or both knee joints prior to entering the service (E. P. T. S.). If roentgenograms had been taken, many of these soldiers would have been disqualified for military service. The line of duty status was not always determinable, frequently because of the difficulty in estimating both the time of onset and the source of the loose bodies. Of 186 cases, in 67 (36 per cent) the lesion was incurred in line of duty (L. O. D.), in 99 (53.2 per cent) it had existed prior to service (E. P. T. S.), and in 20 (10.8 per cent) the time of occurrence was undetermined.

Origin of Loose Bodies.—Osteochondritis dissecans of the femoral condyles and the patella accounted for at least half the loose bodies. The origin of approximately one third of the bodies was not identified either in the roentgenograms or at operation.

Osteochondritis Dissecans.—Of the 97 cases of osteochondritis dissecans, there were 63 in which the loose body was free in the joint and 34 in which the body was still attached to its bed. The attachment was by a pedicle, by a series of adhesions or by continuity with the neighboring articular cartilage.

Of the 63 cases in which the dissecans body was completely separated from its bed, there were 53 cases in which the body remained in one piece; in 10 cases the body had broken into two or more fragments.

When the dissecans body had been separated from its bed for a long period, the bed generally was filled in by dense fibrous tissue. It seldom was necessary to excise any tissue from this type of bed.

Trauma to the Articular Surfaces of Femur and Patella.—In 6 cases a direct blow on a margin of the femoral condyle fractured off a fragment of articular cartilage and underlying osseous cortex to form a loose body. In 15 cases a direct blow to the patella separated a fragment of cartilage and cortex. On one occasion the fractured off fragment represented one third of the patellar articular surface. Fracture fragments of this type are a more frequently encountered source of loose bodies than has been realized in the past. No doubt several such instances are included in the 63 cases of the idiopathic group. When seen several months or years after the injury, the site of origin of the loose body frequently was so completely filled in that it could not be identified.

Two of the 3 cases of osteochondromatosis were typical, and a large number of loose bodies of synovial origin were removed. In 1 case the disease was a rare type in which the multiple free osteochondromas originated not from the synovia but from the articular surfaces of the tibia, femur and patella. Such osteochondromas are epiarticular in origin and develop from small circumscribed areas of reactivated endochondral ossification in the endochondral line of the deep layers of the articular cartilage. Most such osteochondromas appear at the periphery, where there is less mechanical resistance to their growth. Because of the inevitable crowding as the tumors increase in size, many of the tumors were pinched off or fractured off and become loose bodies resembling osteochondromatosis. This case of epiarticular osteochondromas was in a 29 year old dental corps officer who had bilateral involvement of the knee. Symptoms had steadily increased since high school days. An arthrotomy was done on the right knee for the removal of several large loose bodies and a large marginal osteochondroma projecting from the medial femoral condyle. There was temporary improvement, but the officer was unable to tolerate standing for a full day's work, so that he was discharged from the service.

Foreign Bodies.—One of the foreign bodies was a nettle fragment, and the other was a small piece of glass. Both were causing synovial irritation. Recoveries were uneventful.

Number of Loose Bodies.—Of the 186 cases, there was one body in 121 cases, there were two bodies in 24 cases and there were more than two bodies in 41 cases.

The condition in patients operated on after a month or less was principally of traumatic causation. Many of the patients with loose bodies of more than one year's duration were symptom free, but arthrotomy was performed and the loose body removed in order to qualify the soldier for full military duty (generally to qualify for air crew training). Convalescence was rapid, and the end results were good in nearly all cases.

TABLE 6.—*Duration of Symptoms Prior to Operation*

Duration	Number of Cases	Percentage of Cases
1 mo. or less	10	5.4
1 to 6 mo.	9	4.8
6 to 12 mo.	23	12.3
More than 1 year	53	28.5
Not determined	91	49.0
Total	186	100.0

TABLE 7.—*Location of Loose Bodies and Number and Percentage of Cases*

Location	Number of Cases	Percentage of Cases
Anterior compartment	126	67.7
Posterolateral compartment	7	3.8
Combined anterior and posterior compartments	13	7.0
Posteromedial compartment	6	3.2
Osteochondritis dissecans with the body attached to its bed	34	18.3
Total	186	100.0

Diagnosis.—When a loose body was identified in a knee joint, every effort was made to determine its source. This frequently was accomplished with additional roentgenograms taken to show the intercondylar notch of the femur and the superior-inferior aspect of the patella (Waters' position). Occasionally, oblique views of the knee joint were indicated. Routine air roentgenograms were taken only in a small number of hospitals. Their interpretation proved difficult.

Just prior to operation, when a loose body was identified and its location determined, a splint was applied until operation to prevent the loose body from migrating to another part of the joint.

Postoperative Complications.—Pyogenic infection occurred in 3 cases, thrombophlebitis in 2 cases and synovitis (nonsuppurative) in 9 cases. There were no fatalities, and the postoperative complications ultimately came under control.

Results.—Detailed studies of end results are not available, but it is clearly evident that in the majority of cases there were good results. As has been mentioned, there were numerous cases in which there was little or no disability preoperatively, but a loose body had been discovered by the patient or by a medical officer and it was the policy (early in the war) to disqualify the soldiers for air crew duty until the loose body was removed. Although most patients with a loose body in the knee joint recovered fully after operation and qualified for full duty, a few did not recover completely, so that it would have been best for the army had the operation not been performed.

The results of arthrotomy for osteochondritis dissecans varied partly with the size and location of the defect of the articular surface. Large defects directly on a weight bearing area of articular surface generally led to limited endurance and episodes of pain and synovial reaction. Small defects frequently proved compatible with full and strenous military duty. There was a wide variation in individual reaction to the presence of the defect. Defects of long standing frequently were associated with secondary osteoarthritic changes. In such instances the endurance generally was decidedly limited. Patella osteochondritis dissecans often was associated with a neighboring area of chondromalacia. Most patients with patellar osteochondritis dissecans were capable only of limited duty.

Small fracture fragments from the margin of the joint seldom caused any permanent disability after the loose body was removed. Large fracture fragments which left a sizable defect in the articular surface caused lasting disability. In a case in which the fracture fragment involved one third of the patellar cartilage and articular cortex, a patellectomy was performed, from which a good result eventually was obtained.

Convalescence was more rapid and the result generally better when the loose body was removed through a short incision. However, the incision should always be long enough to permit of exploring the joint adequately. A utility incision was seldom necessary. In soldiers, long incisions precipitated more neurotic reactions than did short incisions.

This review indicates that more attention should be given to the examination of the knee joints of inductees. Inductees having large defects of the joint or more than minimal osteoarthritic changes in their knee joints should not be assigned to full military duty.

SURGICAL TREATMENT OF RUPTURED LIGAMENTS OF THE KNEE

Thirty-two operations on ligaments of the knee, performed in Army Air Forces Regional Hospitals, were reviewed. The smallness of this series in relation to the large series of most other orthopedic operations is due to the policy of treating most injuries of the ligaments by conservative methods.

All types of injuries of ligaments of the knee were relatively common in the service, considerably commoner than for the general population. The same sports and obstacle courses that were responsible for the high incidence of lesions of the meniscus also produced a relatively high incidence of lesions of the ligaments.

Prior to the war it was well established that the surgical repair of ruptured ligaments of the knee should be resorted to only when a regimen of thorough conservative treatment had failed. Experience with surgical treatment of the ligaments during World War II did not alter the prewar concept of this subject. In fact, the war experience

TABLE 8.—*Ligaments Repaired or Reconstructed*

Ligament	Number of Cases	Percentage of Cases
Anterior crucial	13	40.6
Posterior crucial	3	9.4
Tibiocollateral	12	37.5
Fibulocollateral	3	9.4
Anterior cruciate plus tibiocolateral	1	3.1
Total	32	100.0

Type of Repair	Number of Cases
Primary suture of crucial ligaments	3
Hey-Groves operation	6
Transplantation gracilis tendon	5
Collateral ligament plasties	16
Mauck operation	2
Total	32

TABLE 9.—*Duration of Lesion*

Duration	Number of Cases	Percentage of Cases
1 mo. or less	13	40.6
1 to 2 mo.	2	6.2
2 to 12 mo.	3	9.4
More than 1 yr.	14	43.8
Total	32	100.0

confirmed the soundness of the pessimistic view long held by most orthopedic surgeons. This did not come as a surprise, since the stresses to which knees are subjected in military service are greater than those in most civilian occupations. Frequently, in the service, the records reviewed indicated that the end result was satisfactory for sedentary work but entirely unsatisfactory for full military duty.

Conservative treatment of injuries of the ligaments of the knee improved during the war. This improvement came from a better appreciation of the capacity of a powerful quadriceps muscle to stabilize the knee. Heavy resistance quadriceps exercises enabled many soldiers to regain good function in their knees. This was an important factor

in reducing the number of cases in which surgical repair had to be employed.

Rupture of the Anterior Crucial Ligament.—A ruptured anterior crucial ligament does not lend itself well either to primary repair or replacement by a strip of fascia lata or tendon. On three occasions in the series herein presented, an attempt was made during the first few days after the injury to suture the ruptured ligament. There were good results from treatment in only 1 of the 3 cases. Difficulty of repair arose from the fraying of the ligament ends and from loss of ligament substance. A rupture of the ligament at its tibial attachment was the easiest type to repair, but, unfortunately, the ligament generally ruptured in the middle or at the femoral end. On one occasion a fragment of bone separated with the ligament at its tibial anchorage. It was a simple matter to reanchor the bony fragment and secure a good result. This case is not included with those in which there were ruptured ligaments but with those in which there were fractures.

TABLE 10.—*Disposition of Cases*

Disposition	Number of Cases	Percentage of Cases
Certificate of disability discharge	10	31.2
Reclassified to limited duty	7	21.9
Disposition not recorded	15	46.9
Total	32	100.0

Results were unsatisfactory in the cases, as a group, in which Hey-Groves operations and modifications were performed. In these operations, use was made of fascia lata or tendon, which was drawn through holes in the external femoral condyle and internal tibial condyle. In most cases the knee appeared stable at the end of six to twelve weeks of immobilization, but with the advent of knee function the transplanted fascia or tendon stretched and the instability returned. In the use of the gracilis, the tendon was severed at its proximal end and left attached distally. A procedure similar to that originally described by Hey-Groves was employed in directing this tendon between the tibial and femoral condyles. Data as to end results are not available.

Rupture of Collateral Ligaments.—The tibiocollateral ligament was more frequently ruptured and more often repaired than was the fibulocollateral ligament. Primary suture was more satisfactory than delayed plastic procedures. However, data as to end results, on which a comparison might be based, are not obtainable.

A wide variety of methods was used to repair the long-standing ruptures of the collateral ligament, but the results left much to be desired.

Results.—As indicated by the fact that 31.2 per cent of the soldiers were given certificate of disability discharges, the results of surgical treatment were poor. There were few assignments in the Army that were compatible with an unstable painful knee. An attempt often was made to limit duty and extracurricular activities to the point that harm would not be inflicted on the knee. But, unfortunately, there were many instances following reconstructive operations on ligaments in which the soldier engaged in sports and other activities for which his repaired knee was unfit, thereby transforming a fair end result into a poor one.

Poor end results often came from traumatic osteoarthritic changes that developed in the knee on the basis of multiple daily traumas from slight to moderate subluxations. Osteoarthritic changes visible in roentgenograms developed in the severe instabilities in the course of two or three years. Such changes were the cause of sharply limited endurance and pain.

TABLE 11.—*Causes of Chondromalacia of the Patella*

Cause	Number of Cases	Percentage of Cases
Acute trauma (contusion, twist or fracture)	16	26.2
Osteochondritis dissecans patella	11	18.0
Recurrent dislocation of patella	7	11.5
Bipartite patella	8	13.1
Generalized osteoarthritis	2	3.3
Idiopathic	17	27.9
Total	61	100.0

CHONDROMALACIA OF THE PATELLA

Chondromalacia of the patella proved to be an important entity during the war. It became clearly recognized as a source of internal derangement of the knee. The records of arthrotomies in Army Air Forces Regional Hospitals indicate that in approximately 5 per cent of the cases chondromalacia of the patella was either the primary lesion or it was secondary to some other lesion of the knee joint. Since the articular surface of the patella was not always examined during arthrotomy there is little question that the true incidence is considerably higher than 5 per cent. Sixty-one cases have been studied in this series.

Acute trauma was unquestionably the principal causative factor. Trauma was inflicted on the patella by direct blows, generally from falls, and from fractures, dislocations (traumatic) and knee torsions. In many instances the specific injury responsible for the subsequent malacic changes was well known to the patient, but in many other cases, in which there appeared to have been a traumatic factor, no history of a specific severe trauma could be obtained. These cases were listed with the group of cases in which the lesion was idiopathic. Trauma was

obvious roentgenographically when there was a fracture extending into the bone, but when the fracture involved only the cartilage it could not be visualized and the injury generally was recorded as a contusion.

Osteochondritis dissecans of the patella caused a variable degree of chondromalacia peripheral to the dissecans body. It was common for the surrounding malacic changes to be extensive.

Recurrent dislocations of the patella have long been associated with chondromalacia of the patella. When the dislocations had occurred numerous times during a period of many years the malacic changes were consistently advanced. When there had been only a brief history, the changes usually were minimal. The point where the margin of the lateral femoral condyle presses against the patellar articular cartilage was the site of maximum degeneration.

In 8 cases, or 13.1 per cent, there were degenerative changes in the cartilage of a bipartite patella. These changes usually were limited to a small marginal body.

There were only two instances in which the chondromalacia of the patella was part of generalized osteoarthritis. This can be accounted for on the basis of the young age group of the patients treated in military orthopedic surgery.

Pathologic Aspects.—Chondromalacia represents a manifestation of degeneration in the articular cartilage. The binding substance holding the collagenous bundles together deteriorates, giving rise to the familiar picture of fibrillation and fissures. With the pressure and friction of continued function, the malacic areas ultimately are worn down to become sites of erosion, exposing the articular cortex. The size of the involved cartilage varied from rounded areas, 1 to 2 cm. in diameter, to a disintegration of the entire articular surface of the patella. Depth of involvement varied from superficial softening and flaking to loss of the entire articular surface. Eventually a "mirror image" of the area of chondromalacia of the patella became evident on the area of the femoral trochlea subjected to friction by the patellar lesion.

Diagnosis.—Internal derangement of the knee from chondromalacia of the patella was rather commonly diagnosed preoperatively as due to a lesion of the meniscus.

Subluxation and dislocations of the patella generally were not difficult to diagnose. It was helpful to take axial roentgenograms of the patella as recommended by Soto-Hall,[24] with the knee flexed 30 degrees and then 60 degrees and a third view with the knee in full extension. Deviations in the path of the patella during knee motions were readily visualized.

Crepitus between the patella and the femur during knee flexion was a prominent symptom. Episodes of pain and increased synovial fluid associated with exertion and knee twists were frequently recorded.

Osteochondritis dissecans of the patella was best visualized in a true lateral view of the patella. A slight overexposure of the roentgenogram was sometimes helpful in outlining the dissecans body.

Bipartite patellar bodies were best visualized in the anteroposterior view and the Waters positions.

Line of Duty Status (L. O. D.)—In 35 patients (57.4 per cent) the derangement was incurred in line of duty (L. O. D.), and in 26 (43.6 per cent) it had existed prior to service (E. P. T. S.).

In most of the cases in which the derangement arose from acute trauma the lesion was incurred in line of duty, whereas in most of the cases in which there was osteochondritis dissecans or dislocation, the condition had existed prior to service. It frequently was difficult to know the line of duty status of cases in which the lesion was of the idiopathic group. When symptoms had started subsequent to military service, they were generally considered as having occurred in line of

TABLE 12.—*Surgical Treatment and Number and Percentage of Cases*

Operation	Number of Cases	Percentage of Cases
1. Patellectomy	7	11.50
2. Curettage, coning and paring	28	45.90
3. Removal of osteochondritis dissecans of the patella	9	14.75
4. Removal bipartite patellar body	8	13.10
5. Transplantation tibial tubercle	9	14.75
Total	61	100.0

duty, although in some cases the changes in the cartilage unquestionably had their onset prior to service.

Treatment (Surgical).—Detailed studies of end results are not yet available. In general, the results from the various procedures were satisfactory in that they usually resulted in diminished pain and increased endurance.

Prior to the war it was the accepted practice during arthrotomy of a joint to excise the advanced area of localized chondromalacia. Such excisions usually were carried down to the osseous cortex, leaving a crater in the articular cartilage. During the war, many orthopedic surgeons deviated from this practice and adopted a more conservative policy. Areas of chondromalacia were excised only if fragments of cartilage were about to drop off, to become free bodies, which was rare, and even then the excision was conservative and did not often create a crater. Since a crater that lies away from the periphery does not fill in (unless the osseous cortex is perforated), the crater can produce more friction against the opposing articular surface than would ordinarily occur from the focus of chondromalacia. It was long held that malacic foci in the articular cartilage ultimately deposited free bodies in

the joint, and this fact justified the crater that resulted from excision of cartilage. Contrary to popular opinion, most areas of chondromalacia do not become a source of loose bodies. The thin flakes and fragments of cartilage that leave the area of malacia through friction are readily absorbed.

For far advanced and symptom-producing chondromalacia of the patella, a radical form of treatment found widespread acceptance during the war. When the articular cartilage of the patella was hopelessly disintegrated and was producing disabling pain, patellectomy gave good results in properly selected cases. In the majority of instances, when such advanced chondromalacia was seen in the soldier age group, it was due either to recurrent dislocations or subluxations of the patella or to an old fracture.

Transplantation of the tibial tubercle with its attached tibial tendon medially was the operation chosen by all of the orthopedists interviewed as the treatment for recurrent dislocations of the patella in which the chondromalacia had not reached a far advanced stage. When there was widespread disintegration of the patella cartilage, a patellectomy was considered to be the best procedure.

PATELLA CUBITI

A New Method of Treatment for Its Avulsion

JOSEPH SACHS, M.D.
AND
GEORGE DEGENSHEIN, M.D.
BROOKLYN

PATELLA cubiti is a condition of the elbow wherein a patella-like bone lies proximal to the olecranon process within the investments of the triceps tendon. A review of the literature reveals less than 25 cases reported to date. The condition was first described by anatomists in 1776, then by Virchow in 1864, by Tillesson in 1874 and by Pfitzner in 1892, who named this bone "sesamum cubiti."

The first clinical report is credited to Cotton,[1] who in 1900 reported 2 cases in a paper entitled "Separation of the Epiphysis of the Olecranon." In 1902 Kienboch [2] reported a single case and named the condition "patella cubiti." In a subsequent article with Desenfans in 1937 in *Presse Medicale* he reported 3 cases and offered a new name, "os epiphysaire del olécranon." [3] Nevertheless, the term "patella cubiti" has remained.

Patella cubiti occurs most commonly in males, and, though usually unilateral, it may be bilateral. Kienboch reported an instance in which it occurred in father and son. He offered the following self-explanatory classification: (1) unilateral, (2) bilateral but unequal and (3) bilateral identical.

The cause of the condition is a subject for much debate; the two schools of thought implicate congenital anomaly and trauma as the origin.

The idea of a homologue of the patella in the elbow was first advanced by Vicq d'Azyr in 1774 and then by Meckel in 1916. Gunn [4] reported that in the ancient Hindu anatomists' writings there exists evidence for a separate ossification center for the olecranon.

From the Surgical Service of Dr. J. E. Miles, Coney Island Hospital.

1. Cotton, F. J.: Separation of Epiphysis of the Olecranon, Boston M. & S. J. **42**:692-694, 1900.

2. Kienboch, R.: Patella Cubiti, Wien. klin. Wchnschr. **16**:634, 1903.

3. Kienboch, R., and Desenfans: Anomalie du squelette de l'articulation du coude, os sesamoide du cubitus, Presse méd. **45**:491-492, 1937.

4. Gunn, G.: Patella Cubiti, Brit. J. Surg. **14**:612-615, 1928.

Other investigators attack vigorously the idea of a homologue of the patella in the elbow.[5] Gunn concluded that patella cubiti must be a persistent separation of the epiphysis of the olecranon, and in his article he supplied a roentgenogram on a 12 year old child showing three separate centers of ossification for this bone rather than the conventional one.

Habbe,[6] in his comprehensive article in 1942, exhausted the literature, and we must respect his conclusion that patella cubiti may be both congenital and traumatic in origin. His third case offers sufficient evidence for a traumatic cause. In this case a 15 year old boy "struck the olecranon region of his acutely flexed elbow on the railing of a fence" during a football game. A roentgenogram showed separation of the olecranon epiphysis and subsequent ones showed further separation, until seven and one-half months later a typical patella cubita had formed.

In any event, patella cubiti, whether congenital or traumatic in origin, is definitely not a result of any injury which takes place after the ossification centers of the elbow close and can in no way be considered a fresh fracture.

DIAGNOSIS

The patient with patella cubiti is always asymptomatic except for mild limitation of extension, which may go unnoticed. Discovery of this anomaly is usually coincidental when other conditions cause roentgenograms to be taken. Avulsion of a patella cubiti, on the other hand, presents a definite clinical picture. The patient usually gives a history of an extension force on the elbow, followed by pain and inability to extend it; on palpation, a moderate-sized bony fragment may be felt posterior to the lower end of the humerus. The fragment is usually mobile and cannot be brought down to the elbow joint unless the elbow is extended.

Roentgenograms reveal a sesamoid bone which, when avulsed, (fig. 1 *A*) lies perhaps 1 to 2 cm. proximal to the olecranon; when not avulsed (fig. 1 *B*), it lies immediately proximal to the olecranon and articulates with it. All edges of this bone are smooth. The most important (roentgenologic) diagnostic feature is the fact that the combined measurement of the ulna and the sesamoid is greater than that of the opposite normal ulna or, in the case of a bilateral patella cubiti, longer than would be expected from the length of the related radius.

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5. Zeitlin, A.: Traumatic Origin of Accessory Bones at the Elbow, J. Bone & Joint Surg. **17**:933-938, 1935. Odessky, I., and Melinkowa, L.: Zur Kasuistik der Patella cubiti, Deutsche Ztschr. f. Chir. **235**:808-809, 1932.

6. Habbe, J. E.: Patella Cubiti: A Report of Four Cases, Am. J. Roentgenol. **48**:513-526, 1942.

This diagnostic feature will help differentiate patella cubiti from traumatic fractures or from avulsions of the olecranon process, with which it is sometimes confused.

TREATMENT

Patella cubiti of itself requires no treatment. There are usually no symptoms, and the mild limitation of extension is not disabling and

Fig. 1.—*A*, roentgenogram of left elbow taken on day of injury demonstrating avulsion of patella cubita, with upward displacement. *B*, roentgenogram of right elbow taken one day after injury to the left, showing nonavulsed patella cubita.

requires no correction. When avulsion occurs, a specific plan of treatment must be followed.

Since few cases of avulsion are reported and since in some instances the condition is passed off as a fracture, there is little in the literature on treatment. In Habbes' third case, previously discussed, the boy was

treated with a sling and later refused surgical repair. In a follow-up examination, there was a definite weakness of the power of extension of the elbow.

In the case herein reported it was elected to use a screw to approximate the sesamoid with the head of the olecranon (fig. 2 *A*). Since the

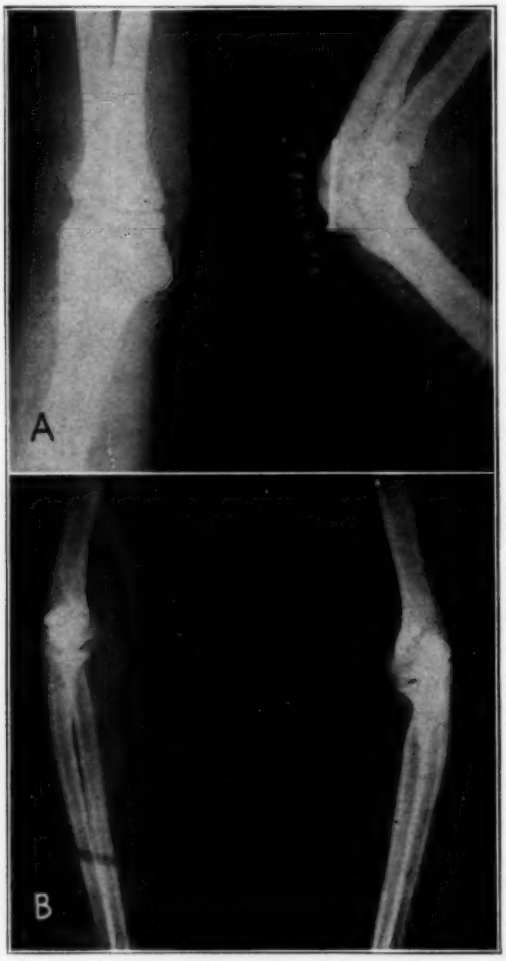

Fig. 2.—*A*, roentgenogram taken one day postoperatively. The patella cubiti is brought into close apposition with the olecranon by means of a screw. *B*, roentgenogram taken three years postoperatively. Note equal extensor ability of both elbows. The screw is intact, with no absorption.

tendinous investment distal to the sesamoid was torn and too thin to be sutured adequately, we feel that this was the treatment of choice as borne out by the result obtained after a three year follow-up during which there was a period of arduous military service.

REPORT OF A CASE

D. M., a 21 year old white man, was admitted to surgical service IV at the Coney Island Hospital on Aug. 22, 1943, with the chief complaint of pain in the left elbow. While doing a handstand on the beach, he experienced a sudden severe pain in the left elbow and thenceforth was unable to extend the forearm. He gave a history of having been extremely athletic throughout childhood. He frequently practiced voluntary falls into the "push-up" position in which he broke the fall with his hands, tensing his partially flexed elbows. Otherwise he recalled no direct trauma to either elbow.

On examination, the patient could flex but not extend the left elbow. Palpation took place within an hour after injury, and little edema was present. There could be felt a bony fragment about 3 by 1 cm. at the lower end of the triceps tendon which moved with that tendon. The bony mass was mobile proximally but had to be forced distally. It is interesting to note that despite definite bony distraction no crepitus was felt. The right, or uninjured, elbow was normal in every respect except for a limitation of extension of about 7 degrees.

A diagnosis of fracture with avulsion of the olecranon was made clinically. A roentgenogram revealed the presence of a patella cubiti in the left elbow measuring 3½ by 1 cm. and separated from the olecranon by at least 2 cm. Further roentgenographic studies revealed a patella cubiti in the uninjured elbow, but it has separated only 1 to 2 mm. from the olecranon. Roentgenograms of the spine and of other bones revealed no further deformities.

Open operation was decided on and was performed on August 25. The distal end of the triceps tendon, after it enveloped the sesamoid, was torn from its olecranon attachment and markedly thinned out so as to prevent adequate suture. The articulating surfaces of the sesamoid and the olecranon were smooth, glistening, geographic and covered with a serous membrane, and they contained a sparse amount of hyaline cartilage.

A no. 32 self-tapping Sherman vanadium steel screw was introduced, which firmly fixed the sesamoid to the head of the olecranon (fig. 2 *A*). The elbow was immobilized in plaster at a 90 degree flexion for four weeks. The wound healed per primum. The patient improved progressively, and on follow-up visits to the clinic there was evidence of rapid return of extensor function but mild weakness of the extremity.

The patient was then inducted into the navy, and he was hospitalized for the complaint of weakness in the left arm when required to carry out the arduous feats of basic training. With rest and physical therapy, he gained progressively until approximately one year after operation he was able to perform all functions with the elbow. It was feared that he would have further limitation of extension, but in figure 2 *B* can be seen the comparative extension of both elbows, with perfect recovery to the extent that the injured elbow could be extended as much as the uninjured one (also containing a patella cubiti).

The roentgenograms in figure 3 were taken in December 1946, which represented a three year follow-up.

The absence of union rules out fracture and further proves the existence of a distinct sesamoid. Clinically the patient is asymptomatic, and he claims that he can

perform all functions with the left elbow. At present he is working where he must lift heavy boxes, and he favors the left elbow occasionally only through fear that he may injure it again.

Result.—The result is obvious from the roentgenograms. We were fortunate in having to deal with a bilateral patella cubiti and so could compare the elbow with an uninjured extremity. After three years the arm with the avulsed patella cubiti has as much extension as, or even a little more than, the one on the opposite side, and there is no residual weakness.

Fig. 3.—Anteroposterior and lateral views three years after operation. Note position of the screw. *B,* both elbows three years after operation. Note full degree of flexion. There is no limitation due to the screw.

SUMMARY

A new case of bilateral patella cubiti with unilateral avulsion is added to the literature. The treatment of choice is rigid fixation of the sesamoid to the olecranon by means of a screw. The diagnosis is proved only roentgenologically, and depends on the fact that the combined length of the patella cubiti and the ulna is greater than normal as well as on the absence of a jagged fracture line.

INTRAPERITONEAL RUPTURE OF THE URINARY BLADDER COMPLICATING FRACTURE OF THE PELVIS

Technics of Repair

RIGDON K. RATLIFF, M.D.
AND
ALVIN S. ISAACSON, M.D.
ANN ARBOR, MICH.

RUPTURE of the bladder is a serious and rare lesion. McCague and Semans [1] reported that in the period from 1905 to 1942, 780 patients with fracture of the pelvis were admitted to the University of Pittsburgh Hospital. In 133, or 17 per cent, the fracture was complicated by rupture of the urethra or bladder. Of the 22 patients with rupture of the bladder, only 6 had the intraperitoneal type, a percentage of 0.8, or a ratio of 1 case of intraperitoneal rupture of the bladder to every 130 patients.

Campbell [2] reported that from 1919 to 1928, 166 patients with fracture of the pelvis were admitted to Bellevue Hospital. In 25, or 15 per cent, of these the fracture was complicated by rupture of the urinary bladder. This analysis does not state the number of ruptured bladders which were of the intraperitoneal type.

In the ten years, from 1936 to 1945, 167 patients with fracture of the pelvis were admitted to the University Hospital, Ann Arbor. In none of these was the condition complicated by intraperitoneal rupture of the bladder. Two, however, had extraperitoneal ruptures.

During the same period, at St. Joseph's Mercy Hospital there were 88 admissions for fractured pelvis. Of these admissions, only 2 patients had complicating rupture of the bladder, which was of the intraperitoneal type in both cases. In 1 case the condition was further complicated by an extraperitoneal rupture. Summaries of the 2 cases follow.

From the Department of Surgery, St. Joseph's Mercy Hospital.

1. McCague, E. J., and Semans, J. H.: Management of Traumatic Rupture of Urethra and Bladder Complicating Fracture of Pelvis, J. Urol. **52**:36 (July) 1944.

2. Campbell, M. F.: Rupture of the Bladder: Clinical Study of Fifty-Five Cases, Surg., Gynec. & Obst. **49**:540 (Oct.) 1929.

CASE SUMMARIES

CASE 1.—A. H., a white woman aged 20, was admitted May 22, 1944 and discharged on August 24. She was admitted at 4. a. m. on May 22, having been injured in an automobile accident about one hour previously. Details of the accident could not be obtained from the patient because of her semicomatose condition.

Examination.—There was evidence of profound shock, and in her semiconscious state the patient complained of pain in the right forearm, the left shoulder, the right thigh and the lower part of the abdomen, accompanied with a bearing-down sensation. Abdominal examination revealed pronounced tenderness in the lower part of the abdomen and over the symphysis pubis. Thorough roentgenologic examination by means of a portable unit revealed comminuted fractures of both pubic rami, fracture subluxation of the right sacroiliac joint, transverse fracture of the midshaft of the right femur, transverse fracture of the midshaft of the right radius and impacted fracture of the surgical neck of the left humerus. On catheterization, only fresh blood could be obtained; accordingly, a solution of sodium iodide was instilled into the bladder, which on roentgenologic examination with the portable unit revealed a rent in the dome of the bladder and escape of the fluid into the peritoneal cavity.

Surgical intervention was delayed for ten hours after the accident, during which time the patient was treated for shock. She received intravenously 2 units of plasma, 1,000 cc. of whole blood and 1,000 cc. of dextrose injection in isotonic sodium chloride solution U. S. P., along with application of heat, adequate administration of morphine sulfate and first aid immobilization of her fractures. On recovery from shock, the patient was taken to the operating room, where, with anesthesia induced with "pentothal sodium" and nitrous oxide, the defect in the bladder was closed.

Operative Procedure.—With a transverse suprapubic incision, the retroperitoneal space was exposed, with the escape of bloody fluid. In the region of the symphysis, multiple jagged bony fragments presented, with a rupture across the neck of the bladder just proximal to the internal sphincter. On opening the bladder, a large rent was observed in the dome, allowing the omentum and a loop of small bowel to herniate into the bladder cavity itself. Because of the insufficient exposure gained by means of the transverse suprapubic incision, a midline incision from the transverse incision was carried up to the umbilicus and the peritoneal cavity opened. The bowel and omentum were then delivered into the peritoneal cavity from the bladder, and the defect was definitely located in the left posterior aspect of the dome The repair of the rupture was facilitated by extending the defect in the bladder and peritoneum to the surgical opening in both the peritoneum and the bladder. This having been done, a continuous line of sutures, started at the peritoneal base of the rupture, was carried to its conclusion and the peritoneal cavity closed tightly, peritoneal exudates having previously been evacuated. The defect in the bladder wall was then closed by placement of interrupted sutures, beginning at the base of the wound of the bladder and carried outward and down to the site of placement of the cystotomy tube. Interrupted sutures were also placed at the level of the symphysis pubis in an effort to restore the extraperitoneal rupture at this point. Penrose drains were left on either side of the bladder in the retroperitoneal area, and the abdominal wall was closed in the usual manner. In order to direct healing, a Foley bag urethral catheter was left indwelling. A Kirschner wire was inserted through the tibial tubercle and the necessary traction applied.

Postoperative Course.—The first four days were marred by clinical evidence of left hemiplegia, which cleared spontaneously. The subsequent postoperative course was uneventful. All of the fractures healed in good functional position, without evidence of osteomyelitis of the pubis. The patient remained in traction for thirteen weeks for the femoral fracture, four weeks in Blake's suspension for the humeral fracture and four weeks in a cast for the radial fracture. Convalescence from repair of the bladder was entirely uneventful. Chemotherapy, with small doses, was maintained throughout her stay in the hospital. The suprapubic tube and the Foley bag catheter were removed six weeks after operation, and three days later she was voiding normally. Repeated urinalyses during her three month residence in the hospital showed a persistent, asymptomatic bacillary infection of the bladder. This was still present, in minimal degree, six months after operation.

Case 2.—R. P., a white woman aged 24, was admitted July 2 and discharged Oct. 28, 1945. She was admitted to the hospital at 9 p. m., having been injured in an automobile accident two hours previously. She was thrown from a car, but the exact reason for the injury could not be elicited.

Examination.—There was clinical evidence of mild shock. The patient complained frequently of intense desire to urinate, with ability to express only a few drops of bloody urine. Physical examination revealed signs of a compound fracture of the left femur, a compound fracture of both ischia and a large laceration in the perineum. There was pronounced tenderness in the hypogastrium and over the symphysis pubis.

On catheterization, 4½ ounces (130 cc.) of bloody urine was obtained; accordingly, a cystogram was made with iodopyracet injection U. S. P. ("neoskiodan") and use of a portable x-ray unit. The roentgenogram revealed a rupture in the superior portion of the bladder, with the dye entering the peritoneal cavity. During the examination, the patient complained of unbearable pain in the lower portion of the abdomen with intense desire to void. The full amount of injected material could not be withdrawn by aspiration after the cystographic examination. Examination with the portable x-ray unit at the same time revealed a comminuted fracture of the midshaft of the left femur, fractures of both ischia and separation of the right sacroiliac joint and the symphysis pubis.

Operative Procedure.—Surgical intervention was delayed for five hours after admission, during which time the patient was treated for shock by means of blood transfusions and intravenous administration of fluids. On recovery from shock, she was taken to the operating room, where her wounds were debrided and the fractures fixed. It was found that the perineal wound did not involve the vagina, bladder or rectum, but exposed the fractures of the pelvis and the anal sphincter on the right side. It did not involve any large vessel or extend into the peritoneal cavity. At the same time, through a transverse suprapubic incision, midway between the umbilicus and the symphysis, the bladder was exposed. When the extraperitoneal space above the bladder was opened, no fluid or evidence of trauma was found. The peritoneal cavity was then opened and a moderate amount of fluid aspirated. A rent was noted in the dome of the bladder on the posterior aspect. The bladder itself was then opened and the rent located from the vesical side. Greater exposure being necessary, the transverse incision was extended downward to the symphysis. In order to facilitate repair of the lesion in the bladder, the rent was continued from the vertex of the bladder by incising in one stroke the peritoneum and bladder wall

between the rent and the surgical wounds of the peritoneum and bladder. The peritoneum was then closed, with a line of sutures begun at the posterior limbus of the rupture and brought anteriorly until the rupture of the peritoneum and the incision in the peritoneal wall were completely closed. A similar line of interrupted sutures was placed on the vesical side of the rupture and incised bladder as far anteriorly as the proposed site of the cystostomy tube. The remaining incision in the anterior wall of the bladder was closed tightly around the catheter. The fascia was then closed with interrupted sutures of no. 32 wire; the skin, with silk.

Postoperative Course.—The patient's convalescence from these operative procedures was entirely satisfactory, intravenous supportive therapy and chemotherapy being used as indicated. At the end of the third postoperative week, the suprapubic tube was removed, and there was immediate onset of bladder function with slight suprapubic drainage, which lasted one week. The function of the bladder remained entirely satisfactory, but was complicated by a chronic bacillary and coccic urinary infection, which persisted, though to a progressively less severe degree, until the time of her discharge.

DIAGNOSIS

It is obvious from these summaries that a person with multiple fractures complicated by rupture of the bladder is seriously ill. To diagnose a complicating rupture of the bladder requires confirmation by a simple anteroposterior cystogram, using a portable x-ray machine. A strongly opaque contrast medium, such as iodopyracet injection U. S. P. ("diodrast"), is preferable to sodium iodide; and when sterile precautions are carried out, the examination adds little to the trauma the patient already experienced and little to the hazard of treatment.

OPERATIVE TECHNIC

Shock having been treated, certain refinements of surgical technic facilitate and speed up the time of operation. Transverse abdominal incision does not allow adequate exposure. The old midline suprapubic incision is preferable. On incision of the rectus sheath, evidence of extraperitoneal rupture of the bladder will be present in the form of urinary or bloody extravasation if such rupture has occurred. Before the bladder is inspected, the peritoneal cavity is opened by a vertical incision and explored. Proof of intraperitoneal rupture is confirmed by free fluid and the presence of a palpable rent in the dome of the bladder. The bladder is then opened by a separate incision in line with the peritoneal incision, and the rupture is palpated from the vesical side. The peritoneal cavity and bladder being open as described, the lesion itself is made to be a continuation of the peritoneal and vesical incisions by incising from below upward the peritoneal reflection and the musculature of the bladder. This having been done, a running stitch of 00 plain surgical gut U. S. P. can be started at the base of

the rupture and brought up along the incised peritoneum to its superior limbus, at which time the peritoneal cavity is tightly closed without drainage. The same procedure is carried out on the vesical side of the incision, a running (or interrupted) stitch of 00 plain surgical gut U. S. P. being started at the base of the rupture and brought up to the superior dome of the bladder, at which time the stitch is tied. A suprapubic tube is now put in place and the wall of the bladder tightly closed about it. Should an extraperitoneal rupture occur, this lesion is sutured, or simply drained by means of a Penrose drain. The fascia is closed with interrupted sutures of fine wire or tantalum. The skin itself is closed with the suture of choice.

CONCLUSION

The successful treatment of these rare and dangerous lesions consists, first, in the treatment of shock; second, in the diagnosis of the lesion, and, third, in early operation. The technic described has for us facilitated the operative procedure. The use of modern knowledge of protein metabolism, water balance and chemotherapy will, of course, hasten convalescence.

326 North Ingalls Street.

Surgical Clinics

CLINIC ON DISEASE OF THE BILIARY TRACT

FRANK GLENN, M.D., AND STAFF
NEW YORK

CHAIRMAN (DR. FRANK GLENN): The clinic this morning will be as usual except that it is being reported. The purpose of the first part is to give a picture of our general approach to problems of the biliary tract and of the common duct in particular. Dr. Hooker:

DR. HOOKER: Mrs. B. was admitted to the hospital for the second time on Oct. 7, 1947, with the chief complaint of intermittent fever of two months' duration. The first admission was in November of 1946 for acute cholecystitis and choledocholithiasis with cholelithiasis.

On the evening of her first admission a diagnosis of acute cholecystitis was made and an emergency laparotomy performed. At this time the gallbladder was found to be distended, tense and subacutely inflamed. Numerous stones could be felt within the common duct. Exploration of the common duct was performed, and numerous stones were removed from it. A probe could be introduced into the left hepatic bile duct but not into the right. The gallbladder was removed and T tube drainage of the common duct instituted. Cultures of the gallbladder and subsequently of drainage from the wound contained Clostridium welchii, Bacillus coli and Aerobacter aerogenes. Postoperative cholangiograms showed no filling of the right hepatic duct, although the opaque medium passed readily into the duodenum.

Mrs. B.'s postoperative course after the first admission was entirely uneventful, and she was referred to the outpatient department for further follow-up.

CHAIRMAN: May we see the cholangiograms?

DR. JASPER: This is the left hepatic duct. There was no filling of the right hepatic duct. There is patency of the common bile duct, and opaque medium is present within the second portion of the duodenum.

CHAIRMAN: Do you think that this means occlusion of the right hepatic duct?

DR. JASPER: It is possible, but I am not sure.

CHAIRMAN: Is it not true that if there is a patent common duct opening into the duodenum there may not be good visualization of the entire biliary tree?

DR. JASPER: That is possible.

DR. HOOKER: After her discharge from the hospital, the patient ran an intermittent low grade fever but felt generally well and gained weight. Approximately seven weeks from the time of her discharge, a single stone 1 cm. in diameter passed from the common duct drainage tract, after which the tract closed; thereafter she was well until approximately eight months from the time of her discharge from the hospital. At this time she experienced recurring chills and fever, transient

From the Surgical Grand Rounds, New York Hospital, Nov. 22, 1947.

jaundice and pruritus, cramplike epigastric pain with occasional vomiting and a progressive weight loss of 10 pounds (4.5 Kg.).

Physical examination on the second admission showed her to be an adequately nourished and well developed white woman of approximately 45 years in no apparent distress. The temperature was 37.4 C. (99.3 F.), the pulse rate 90, and respirations 18 and the blood pressure 110 systolic and 70 diastolic. There was a slight icteric tint to the skin and numerous scratch marks noted over the posterior thorax. The head and neck were normal save that the thyroid gland was diffusely enlarged, approximately twice the normal size. The heart and lungs were normal. The abdomen was flat and soft, with a well healed right upper rectus scar and slight tenderness in the right upper quadrant. The rectal and pelvic examinations revealed nothing abnormal.

Examination of the urine revealed a trace of albumin and no bile. The blood counts on her admission to the hospital were within normal limits, the red blood cell count being 4,700,000, the hemoglobin content 12.5 Gm. and the white blood cell count 8,600 to 12,600, with a normal differential count. The Mazzini test was negative. The blood urea nitrogen was 19 Gm., the protein content 7.6 Gm., the albumin-globulin ratio 4.8 to 2.8 Gm., the serum bilirubin 0.61 mg. and the alkaline phosphatase 18.6 mg., per hundred cubic centimeters.

CHAIRMAN: What was the normal alkaline phosphatase content?

DR. HOOKER: About 6 to 8.

Cultures of material from the common duct at the time of the first operation yielded Cl. welchii, B. coli, A. aerogenes and Bacillus fusiformis. Roentgenograms of the gastrointestinal tract after a barium enema and of the chest were normal. On the eighth day in the hospital the patient was subjected to exploration of the common duct under general anesthesia.

CHAIRMAN: Before we proceed, let us pause a moment to see if our diagnosis at that time may have been correct. Had this woman had any transfusions prior to or during her first stay in the hospital?

DR. HOOKER: Yes, she did have transfusions.

CHAIRMAN: How long was the interval between the first and the second admission?

DR. HOOKER: Approximately one year.

CHAIRMAN: Was she jaundiced before this admission? What was her icteric index?

DR. HOOKER: Yes, slightly. Her icteric index was 10.

CHAIRMAN: Almost normal. You felt that the most likely diagnosis at the time of her second admission was recurrent attacks of cholangitis with jaundice?

DR. HOOKER: Yes, with transient recurrent jaundice.

CHAIRMAN: And that there was something in her common duct due either to stone or possibly to distortion of the duct?

DR. HOOKER: We felt that stone was most likely.

CHAIRMAN: It certainly would be in view of the fact that stones had been found there before. Other possibilities always have to be considered in the presence of jaundice even after operation, and after operation at the present time it seems to me that there are certain definite clinical entities which should be considered. Dr. Andrus, do you care to comment on these?

DR. ANDRUS: One of the most common is stricture of the common duct. It should have made itself known before the passage of the stone. It might be the

result of external injury to the duct at the time of operation or of abnormal healing of the opening in the common duct. Again, it may arise from ulceration within the duct produced by the presence of a stone.

CHAIRMAN: Dr. Moore, are there any other conditions producing jaundice which we might be concerned with?

DR. MOORE: I think that we can discount the fact that the patient had transfusions on the previous admission. After a year it would be unusual for homologous serum jaundice to develop, and I think that it is fairly definite that the diagnosis is stone in the common duct.

Fig. 1.—Cholangiogram taken at the time of operation. A shadow suggestive of a stone can be seen in the right hepatic duct.

CHAIRMAN: Will you proceed?

DR. HOOKER: On the eighth hospital day the patient was subjected to exploration of the common duct under general anesthesia. One stone, measuring approximately 1 cm. in diameter, was removed with little difficulty from the lumen of the right hepatic duct. A normal biliary tree was verified by cholangiograms taken at the time of operation and after removal of the stone.

DR. JASPER: These cholangiograms were made at the operating table, and you will notice a definite filling defect in the right hepatic duct, which was not seen before and which undoubtedly represents the stone that was mentioned as having been removed (fig. 1).

CHAIRMAN: Were these taken before or after removal of that stone, Dr. Hooker?

DR. HOOKER: One was taken before the stone was removed and one after.

CHAIRMAN: Was this stone easily removed? Was it obvious before the cholangiogram was taken, or was it revealed by the cholangiogram?

DR. HOOKER: The cholangiogram revealed it.

DR. MOORE: May I add that the cholangiogram in this instance was of tremendous help. I was present, and Dr. Hooker had some difficulty in locating

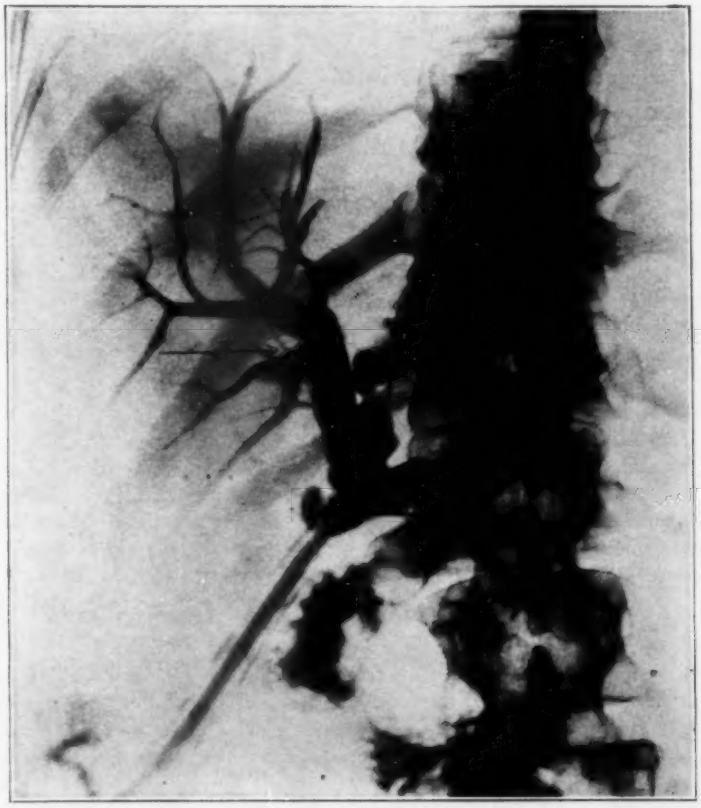

Fig. 2.—Cholangiogram taken after operation shows that the shadow in figure 1 has disappeared.

the stone, but by means of this cholangiogram he was able to go to the exact spot and find the stone.

CHAIRMAN: Was it free or lodged firmly? Did you remove it readily?

DR. HOOKER: It was easily removed.

DR. JASPER: The second roentgenogram demonstrates the biliary tree the following day, and you will notice that it presents an entirely normal appearance, with complete patency of the common duct (fig. 2).

CHAIRMAN: May I ask about the left hepatic duct as seen in that roentgenogram?

DR. JASPER: It does look incompletely filled. Perhaps the margins are irregular, but I would not care to say more than that about the duct.

CHAIRMAN: Would you comment on the lack of opacity just beyond the tube? It looks almost like a stone.

DR. JASPER: It is more likely due to incomplete filling rather than to a stone in view of the complete patency of the common duct. We are unable to demonstrate any evidence of a stone in that area in other cholangiograms, and certainly a large amount of opaque material has gone into the small intestines, which does not suggest a stone.

DR. HOOKER: The postoperative course has been entirely uneventful.

CHAIRMAN: How long was the common duct tube left in, Dr. Hooker?

DR. HOOKER: Ten days.

CHAIRMAN: Dr. Moore, would you list what you consider indications for exploration of the common duct and also the types of exploration which you think simplest and most complete?

DR. MOORE: There are several indications for exploration of the common duct which we feel are definite. The first is the palpation of stones within the common duct unless there is some definite contraindication to the procedure, the second is the presence of jaundice at the time of operation or a history of previous jaundice and the third is the finding of a dilated, common duct. Then there are indications which are not so definite, such as induration of the head of the pancreas and possibly a history of repeated attacks of cholangitis.

As for the method of exploring the common duct, exploration through the cystic duct probably gives less chance for subsequent stricture or distortion of the common duct. In case the cystic duct is dilated, the common duct can be explored by means of a probe or forceps. The cystic duct may be dilated to aid in this exploration.

CHAIRMAN: Dr. Moore, do you not think that as a rule exploration through the cystic duct is unsatisfactory?

DR. MOORE: At times it is unsatisfactory, and when a more complete exploration is desired, I think it is better to place traction stay sutures on the common duct and, by means of an adequate longitudinal incision, to open the common duct. It can then be explored by means of catheters or forceps, or even a finger may be introduced. This is not always satisfactory, because with induration of the head of the pancreas it is possible for a stone lodged in the ampulla to be obscured. For this reason we at times explore through the duodenum and thereby insure a more adequate examination.

Additional help has been presented in the form of cholangiograms. A number of physicians feel that these should be made routinely at the operating table. We do not make routine cholangiograms at the time of operation; however, we are of the opinion that they should be made before the tube is removed from the common bile duct.

The common duct should be drained for stones when it is opened. At times it may be drained by a small tube through the cystic duct. We also drain by means of a T tube in the duct.

When the dressing is placed on the patients, care should be taken to see that the drainage tube is securely fastened. We have been somewhat chagrined in

certain instances when the drainage tube was removed by the patient coming out of the anesthesia or when it was removed at a subsequent dressing.

When should the tube in the common duct be removed? It should be left in place until there is an adequate flow of bile and until this flow of bile is clear. It may be well to do microscopic studies of the bile to determine the presence or absence of pus. We like to leave this tube in place until we are sure that there is bile passing through the duodenum. This can be determined by the color of the stools.

We expect the jaundice to subside promptly, which it usually does, a decrease being evident within twenty-four to forty-eight hours. We prefer to have a cholangiogram to determine whether the stones have been completely removed before removal of the tube. The tube is left in place from ten to fourteen days and then removed.

CHAIRMAN: Dr. Barnes, if a stone is observed in a late cholangiogram, when do you think would be the optimum time for its removal?

DR. BARNES: It would vary, depending on whether the patient is having signs or symptoms which may be related to the stone. If proximal to the point at which the tube enters the biliary system, it might be associated with the chills, fever and other evidence of cholangitis. In that instance I think it would be important to remove the stone as soon as possible. If the stones were more distal and the biliary drainage continued well to the outside, there would then not be such an urgent need for removal of the stone. Any time the patient's general condition warranted operation, it could be removed. The wound should be allowed to heal and any evidence of infection present in the wound should have disappeared before an attempt is made at removal.

CHAIRMAN: Dr. Child, it is evident that in this instance the stone may well have been present at the first operation. From our experience here, would you say that this happens often?

DR. CHILD: One can answer that indirectly by referring to the figures. We have done approximately 2,500 operations for nonmalignant disease of the biliary tract. In about 12 per cent of these the patients (302) have had their common duct explored at the time of the original operation (table 1).

TABLE 1.—*Incidence of Stones in the Common Duct from 1932 to 1946*

Operations for nonmalignant disease of the biliary tract	2,500
Explorations of the common duct	302 (12 per cent)
Instances in which stones were present	135 (44.7 per cent)

Of these 302, 135, or 44.7 per cent, have had stones. This means that somewhat under half of the common ducts which are opened can be expected to yield stones at the original operation.

We studied these data from the point of view of the age of the patients involved, and in a series of 100 patients, of whom 47 had stones in the common duct at the time of exploration, 40 were under 50 years of age. In this group stones were found in 15 patients, or 37 per cent. Of the 100 patients, 60 were over 50 years of age and, as you can see, the number with stones, i. e., 32, or 53.3 per cent, is considerably higher than in the younger age group (table 2).

Ninety-six of the 100 patients have been followed for six months to fifteen years. Of this entire group, a total of 8 patients, in 6 of whom stones were present at the original operation, had to return at some later date for the

further removal of stones. Of 47 patients with stones in the common duct, the stones recurred or were missed at the original operation in 6 (12.8 per cent). Stones unquestionably are missed at the time of the original operation (table 3).

In some instances it was hard to believe, on examination of the stones, that they could have formed in the relatively short period which had elapsed between the first and the second operation. One patient who did not have a stone at the original operation returned two years later with evidence of obstruction of the common duct which was due to distortion of the duct because of adhesions present. In another case exploration revealed no stones, and the patient returned later and had a stone removed.

CHAIRMAN: The problem which exists when there is exploration of the common duct is that of being able to remove all the stones present. Any adjuvant is of help, and the most important one at the present time is the use of cholangio-

TABLE 2.—*Incidence of Stones in the Common Duct as Influenced by Age (1932 to 1938)*

100	patients with exploration of common duct stones
47	had stones (47 per cent)
53	had no stones (53 per cent)
40	patients under 50 years of age
15	had stones (37.5 per cent)
25	had no stones (62.5 per cent)
60	patients over 50 years of age
32	had stones (53.5 per cent)
28	had no stones (46.7 per cent)

TABLE 3.—*Follow-Up Results (1932 to 1938)*

100	patients with exploration of common duct
47	had stones (47 per cent)
53	had no stones (53 per cent)
96	patients followed for 6 months to 15 years
12.8	per cent of patients with stones had a recurrence
1	patient with no stones on exploration later had a stone removed from the common duct
1	patient with stones removed had bands causing obstruction at exploration two years later.

grams. Cholangiograms, carefully done, require close cooperation between the x-ray and surgical departments.

The main problem, of course, in cases of obstruction of the common duct always is jaundice. In the treatment of jaundice, we require a differential diagnosis between obstructive jaundice and jaundice due to intrinsic disease of the liver.

Dr. Andrus, what do you consider the most important laboratory data that we employ in this differential diagnosis?

DR. ANDRUS: The laboratory data of importance relate to the functions of the liver. In any large series of cases of intrahepatic jaundice, the hepatic function will be abnormal in a variety of tests in about 90 per cent. This is not absolute. If jaundice has been present from an extrahepatic source or if there has been preceding damage to the liver such as may arise in cirrhosis, a false picture may be given.

There is a variety of liver function tests that can be used. Some years ago Dr. Lord and I ran a series of tests in differential diagnosis, using prothrombin

and the response to vitamin K. We found that this test enabled a positive differential diagnosis to be made between intrahepatic and extrahepatic jaundice in 70 to 90 per cent of the cases. At present I think that the cephalin flocculation and thymol turbidity tests as well as the alkaline phosphatase test are more frequently used than they were previously. To decide about hepatic function one should use a battery of tests and not rely on any single test in a large group. If the hepatic function appears to be definitely abnormal, it should be assumed that the jaundice is intrahepatic until it can be proved otherwise and vice versa, it being remembered that prolonged jaundice from any source can be associated with increasing damage to the liver.

CHAIRMAN: The longer the period of jaundice, the more difficult is the differential diagnosis as a rule. As far as laboratory data are concerned, I believe that in early jaundice there are a few simple indications which are of great help and sometimes not always noted. One is the presence of bile in the urine and the absence of bile in the stool. There is also the presence of urobilinogen in the urine, indicating hepatic damage.

As Dr. Andrus has said, patients with long-standing jaundice have hepatic damage regardless of the primary course of the disease. It is this group of patients in which we have the greatest percentage of error. Likewise they afford us the greatest difficulty clinically. Probably the most important contribution to surgery of the biliary tract in recent years has been the use of vitamin K and the estimation of the prothrombin time of the blood serum. Our mortality rate among patients with jaundice has been markedly lowered in this clinic. We have not, so far as I know, lost a patient because of a bleeding tendency since we began to use vitamin K to control this tendency in obstructive jaundice.

Dr. Moore, have you anything to say in reference to our general outline of preoperative preparation?

DR. MOORE: Operation on a patient for stone in the common duct is never such an emergency that it must be done without proper preoperative preparation. In case it is felt that an emergency procedure should be carried out, it is best to do the simplest procedure possible. When the gallbladder is in place, it may be better merely to do a cholecystostomy and reserve exploration of the common duct until later. This will decompress the biliary tract and tide the patient over in the emergency.

The fluid balance should always be carefully evaluated and corrected before the patient is taken to the operating room. If the patient is dehydrated because of vomiting or of being unable to take fluids by mouth, parenteral administration of fluids rapidly restores fluid balance. It is important to look to the red blood cell count and the hemoglobin content. If these are diminished, they should be corrected, preferably by transfusion.

Hepatic damage is particularly important in all cases of obstruction of the common bile duct, and it is for this reason that not only the total plasma protein level but also the albumin and globulin ratio should be determined. When the plasma protein level is lowered, it can best be raised by means of a transfusion. This is done at times by means of plasma alone; however, because of reports of jaundice following the use of pooled plasma, it seems best to use this type of therapy only as an emergency. Proteins in adequate quantities by mouth will increase the amount of protein in the blood. At times amino acids can be given by the parenteral method. As a general rule this will not raise the blood protein level, but it will prevent further depletion.

Before operation it is essential that the liver be fortified. The glycogen stores may be markedly depleted, and we know that trauma to the liver is withstood far

better when the stores are replenished. For that reason the patient should have a high carbohydrate diet before operation and, if necessary, dextrose intravenously. By means of a high protein diet proteins in the body can be further restored.

Patients who are jaundiced have at times a markedly diminished prothrombin content in the blood. This substance is prepared in the liver, and after hepatectomy it shows a rapid decrease. For the formation of prothrombin it is necessary that vitamin K be present, and for the ingestion and absorption of vitamin K it is necessary to have bile salts. The determination of the amount of prothrombin is estimated indirectly by measuring the accelerated clotting time of the blood, which is generally called the "prothrombin time." This is then given in percentage of normal value, i. e., a prothrombin time of 100 per cent, or normal, corresponds to a clotting time of about twenty-five seconds. When the prothrombin time is lowered, it can usually be raised promptly by the use of vitamin K and bile salts. With these we have almost completely corrected any tendency toward bleeding. By these means I think that we can prepare the patients so that they can withstand operation on the biliary tract without any real difficulty.

DR. ANDRUS: We should bear in mind that when serious damage to the liver is present no amount of vitamin K will raise the prothrombin level. The simple administration of vitamin K is not enough. There is a means whereby we can sometimes tide over a patient with severe hepatic damage, and that is going back to the old methods that we used before vitamin K was available. It is known that a transfusion of whole blood or even of citrated blood will contribute prothrombin among other things, and the prothrombin level can be raised in that way.

CHAIRMAN: That is true. Certainly if the liver is damaged, it will not respond, and I think Dr. Moore has in mind the patient who has stone in the common duct and mild intermittent obstruction and therefore not a great deal of hepatic damage. We are much concerned about the liver as far as anesthesia is concerned. Dr. Artussio, would you discuss briefly anesthesia in the presence of obstructive jaundice?

DR. ARTUSSIO: Because of the absorptive function of the biliary tract, premedication is important in biliary tract disease. We think that meperidine ("demerol") is a better drug to use than morphine because of the prolonged intensification of the morphine effect in cases of hepatic damage. The agent, of course, is important. Tribromoethanol alcohol "avertin" chloroform and ether will offend the already damaged liver. Cyclopropane, so far as we know, is innocuous for a liver that is already damaged. Curare is an accepted adjuvant for relaxation, although it is partially destroyed in the liver. We have not found in this clinic that there has been a prolongation of its effect, so we feel that cyclopropane is the anesthesia of choice and "demerol" the choice for premedication.

As for the technic used, we think that the patient should be intubated because of the frequent regurgitation of bile into the stomach and of possible regurgitation and aspiration, with resultant pneumonitis. With an endotracheal tube in place, the entire pulmonary area and the tracheobronchial tree are protected.

DR. ANDRUS: I think that one other point should be made. When induration of the head of the pancreas is present and other indications are also present for exploration of the common duct, it is wise to determine the cause of the induration before opening the duct. The opening of the duct in the presence of carcinoma of the pancreas may be at least an inconvenience and at most an extremely embarrassing complication.

CHAIRMAN: Would you suggest biopsy of the pancreas?

DR. ANDRUS: It would depend on the type of induration and on the location. If it is immediately at the site of the ampulla, transduodenal exploration is probably best, and in most instances it will be found to be due probably to pancreatitis. Our experience with biopsy in the diagnosis of carcinoma of the pancreas versus pancreatitis has not been too satisfactory.

CHAIRMAN: What is our batting average for the diagnosis of carcinoma?

DR. CHILD: About 50 per cent of all cases. Dr. Andrus, do you not think that we could extend that to include the biliary tract?

DR. ANDRUS: Of course.

DR. CHILD: It is most embarrassing to find oneself having to do a substitute procedure if the gallbladder has already been removed.

I should like to ask a question about the problem of differential diagnosis. I have heard Dr. Whipple mention many times that a jaundiced patient should not be studied to death, the implication being that in cases in which there is difficulty in making a differential diagnosis operation should be resorted to more frequently than it is at the present time. I think that every large series of patients is replete with postoperative evidence which points to the fact that exploration should have been carried out much earlier.

CHAIRMAN: That is true. With the armamentarium which we have at the present time, preoperative preparation, safe anesthesia and careful surgical procedures, there is no reason to delay operation after a reasonable period, i. e., within a week or ten days, when the diagnosis is doubtful.

Are there any other questions?

DR. PATTERSON: I have seen four fistulas of the duodenum in the last year following opening of the duodenum to remove stone from the ampulla or for exploration. I wondered how often that happens and what could be done about it.

CHAIRMAN: Did you, Dr. Patterson, see the patients in this clinic?

DR. PATTERSON: I saw 1.

CHAIRMAN: The occurrence of duodenal fistula following transduodenal exploration is, I think, due to inadequate closure. If it is not due to inadequate closure, then there is a fault in the healing mechanism. In a person with jaundice who has a lowered protein level the latter may be true, but if the duodenum is closed carefully with interrupted sutures of silk, the incidence of this should be low. There should be less hesitancy about transduodenal approach because undoubtedly stones can be removed from that direction with less damage to the liver and to the common duct.

DR. CHILD: It is interesting when one goes back and reviews all the cases in which ampullary tumors were removed by the transduodenal approach. The general consensus is that it was difficult to remove these tumors because of the various complications including fistula and hemorrhage. They were probably due to the fact that it was closed with an absorbable suture material such as surgical gut. It has been appreciated that this is rapidly ingested in the presence of ferments. With abandonment of surgical gut and the use of the nonabsorbable suture material, the whole picture has changed radically. Fistula in the duodenum used to be an extremely grave problem; now, I think, it should disappear.

DR. MOORE: We looked up the records of 100 patients who had been operated on prior to 1938, and we had follow-up data on 96.

CHAIRMAN: Which is, I think, excellent.

SUMMARY

A case is presented in which there was a history of previous operation for chronic cholecystitis with stones and choledocholithiasis. On readmission to the hospital the patient had symptoms suggestive of obstruction of the common duct due to stone. At operation a stone was found in the right hepatic duct.

The method of differential diagnosis in obstruction of the common duct is discussed, including values of various laboratory tests and the use of the cholangiograms. Indications for exploration of the common bile duct include (1) palpation of stones within the duct, (2) the presence of or history of jaundice and (3) the finding of a dilated common duct. The preoperative preparation of the patient and the use of anesthesia in surgery of the biliary tract are also discussed.

Methods of exploration of the common duct include (1) examination through the cystic duct, (2) incision into the common duct and (3) the transduodenal approach.

Of approximately 2,500 patients operated on for nonmalignant disease of the biliary tract, 302 (12 per cent) were subjected to exploration of the common duct. Of these, 135 (44.7 per cent) had stones.

One hundred of the patients who had undergone exploration of the common duct were operated on from 1932 to 1938. In this group 47 (47 per cent) had stones. Ninety-six have been followed for six months to fifteen years. Of the patients in this group, 6, or 12.8 per cent of those who had stones removed, have had recurrence of stones in the common duct. One patient had stones removed some time after a previous exploration had failed to reveal stones.

Questions and Answers

GASTRIC RESECTION FOR DUODENAL ULCER

WALTMAN WALTERS, M.D.
AND
E. R. TAYLOR, M.D.
ROCHESTER, MINN.

QUESTION: Could you refer to any follow-up information proving that the amount of stomach removed (in addition to the prepyloric region) influences the more permanent relief of symptoms (in gastric resection for duodenal ulcer)?

ANSWER: There is much evidence showing that the relief of symptoms following gastric resection for duodenal ulcer depends on the amount of acid produced by the stomach. Likewise much evidence indicates that the greater the amount of stomach removed the greater the reduction in the acidity of the gastric contents. Some of this evidence will be presented briefly.

Rienhoff [1] clearly demonstrates the relationship of postoperative acidity to the relief of symptoms. He studied 260 cases in which operations were performed on the stomach. He found that in the group of well patients the average amount of free acid after operation was 13 degrees, in the improved group 36 and in the unimproved group 53. His operation removed roughly 50 per cent of the stomach including the pyloric antrum.

Friedell [2] found that anacidity was present after fasting in 74.4 per cent of 43 cases in which an estimated half of the stomach was removed and in 76.9 per cent of 65 cases in which more than half of the stomach was removed. A continuation of the studies reported by Friedell, Shaar and Walters [3] verified the earlier report, with the additional observation that in 25 per cent of the cases almost absolute achlorhydria occurred.

The work done at Cornell and written up by Heuer, Holman and McSwain [4] dealt with less than 100 cases of duodenal ulcer. These

1. Reinhoff, W. F., Jr.: An Analysis of the Results of the Surgical Treatment of 260 Consecutive Cases of Chronic Peptic Ulcer of the Duodenum. Tr. South. S. A. **56**:199-215, 1944.

2. Friedell, M. T.: Partial Resection of the Stomach: The Effect of Its Extent on Gastric Acidity. A Preliminary Survey. Proc. Staff Meet., Mayo Clin. **16**: 193-197 (Mar. 26) 1941.

3. Friedell, M. T.; Shaar, C. M., and Walters, Waltman: Effect of Gastric Resection on Gastric Acidity. J. A. M. A. **120**:666-670 (Oct. 31) 1942.

(Footnote continued on next page)

investigators found that removal of more than the pyloric antrum resulted in a greater reduction in the acidity than removal of only the antrum. They did not find that resections of more than half of the stomach gave better clinical results than resections of half of the stomach. However, in all their cases marginal ulcers occurred in patients who had concentrations of free hydrochloric acid of 60 degrees or more after operation. Thus the recurrences were related to the acidity.

Graham,[5] of Toronto, has come to resect more of the stomach for duodenal ulcer because resection of only a small portion results in recurrence in his experience. He employs a "radical subtotal resection," including the pylorus and the greater part of the lesser curvature. With the use of this procedure in 131 cases of duodenal ulcer he had only one recurrence.

Wangensteen [6] in his many publications has stated that the acid is the most important factor in the causation of peptic ulcer and of the recurrences after resection. He has found that the gastric acidity varies directly with the amount of stomach resected. The pyloric antrum must be removed. In 63 per cent of 82 cases in which three quarters of the stomach was removed for peptic ulcer persistent achlorhydria was present after administration of histamine.

He has concluded that resection of three fourths of the stomach should be carried out for duodenal ulcer. In 1947 he wrote that in the previous eight years 500 gastric resections had been performed in his clinic for peptic ulcer, with only two recurrences.

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4. Heuer, G. J., and Holman, Cranston: The Effect on Gastric Acidity of Gastro-Enterostomy and Gastric Resection for Peptic Ulcer. Ann. Surg. **118**: 551-557 (Oct.) 1943. Holman, C. W., and McSwain, Barton: Gastric Acidity Following Gastric Resection. Surgery **13**:916-923 (June) 1943.

5. Graham, R. R.: Technical Surgical Procedures for Gastric and Duodenal Ulcer. Surg., Gynec. & Obst. **66**:269-287 (Feb. 15) 1938.

6. Wangensteen, O. H.: The Role of the Surgeon in the Management of Peptic Ulcer. New England J. Med. **236**:191-196 (Feb. 6) 1947. Wangensteen, O. H., and Lannin, Bernard: Criteria of an Acceptable Operation for Ulcer; The Importance of the Acid Factor. Arch. Surg. **44**:489-500 (Mar.) 1942. Wangensteen, O. H.; Varco, R. L.; Hay, Lyle; Walpole, Stewart, and Trach, Benedict: Gastric Acidity Before and After Operative Procedure with Special Reference to the Rôle of the Pylorus and Antrum; A Preliminary Report of a Clinical and Experimental Study. Ann. Surg. **112**:626-670 (Oct.) 1940.

REVIEW OF UROLOGIC SURGERY

ALBERT J. SCHOLL, M.D.
LOS ANGELES
FRANK HINMAN, M.D.
SAN FRANCISCO
EDMUND CROWLEY, M.D.
LOS ANGELES
ALEXANDER B. HEPLER, M.D.
SEATTLE
ROBERT GUTIERREZ, M.D.
NEW YORK
GERSHOM J. THOMPSON, M.D.
AND
EDWARD N. COOK, M.D.
ROCHESTER, MINN.
AND
VINCENT J. O'CONOR, M.D.
CHICAGO

KIDNEY

Anomaly.—Hanley and Steel [1] discuss solitary ectopic kidney and add 2 cases which make a total of 44 cases reported. Since publication of their paper, 2 additional cases have been described by Mays, Schrieber and Smith. Every female whose case is recorded had some associated genital anomaly; this fact is good reason for a full urologic investigation in all such cases. The cases were divided about equally between males and females. Few of the patients presented themselves for reasons associated with urologic problems. The most frequent symptom was pain in the lower region of the abdomen; the commonest sign was a palpable tumor. In many cases a solitary ectopic kidney is undoubtedly overlooked at operation. Appendectomy was performed on at least 3 patients. Earlier reports show that in 2 cases the solitary kidney was removed; in another case it was opened by mistake for the uterus, and another time biopsy was performed. The mortality rate among patients subjected to operation is high.

Benign Neoplasm.—Fuchsman and Angrist [2] discuss the origin of benign renal tumors based on a series of seventy-nine tumors which were found among 3,456 consecutive necropsies performed at Queens

1. Hanley, H. G., and Steel, W. A.: The Solitary Ectopic Pelvic Kidney with Reports of Two Further Cases, Brit. J. Surg. **34**:402-407 (April) 1947.

2. Fuchsman, J. J., and Angrist, A.: Benign Renal Tumors, J. Urol. **59**:167-173 (Feb.) 1948.

General Hospital over a period of seven years, from 1936 through 1942. In 16, or 27 per cent, of the 59 cases studied multiplicity of tumors was present. The average age of the patients at the time of death was 58 years. Forty-three, or 73 per cent, had varying degrees of sclerotic changes in the kidney; one tumor, an adenoma, had been removed surgically. In other cases there were minute neoplasms, often so small they could not be seen with the naked eye.

A classification of the categories of tumors encountered, their incidence and the mean age of the patients are given in table 1.

Epithelial tumors appear to develop on the basis of vascular changes, tubular isolation and segmentation, cyst formation and neoplastic proliferation of the lining membrane. Some epithelial neoplasms and connective tissue tumors, particularly the mixed forms, probably have a common origin, representing varying differentiation of original nephrogenic mesenchyme.

TABLE 1.—*Incidence of Tumors and Mean Age of Patients*

Epithelial Tumors			Connective Tissue Tumors		
Tumor	Incidence	Age, Yr.	Tumor	Incidence	Age, Yr.
Papillary cystadenoma..	12	62.9	Fibroma.....	11	49.2
Papillary adenoma.....	17	58.0	Leiomyoma.....	13	62.5
Tubular adenoma.....	4	61.2	Mixed (muscle, fat).....	3	50.3
Clear cell adenoma.....	11	56.4	Adenomyoma.....	1	74.0
Granular cell adenoma..	6	60.3	Lipoma.....	1	70.0

Oddo [3] reports the successful removal of a simple cyst of the renal pelvis which was diagnosed preoperatively with the aid of intravenous pyelograms. A channel connected the superior calyx and the cyst. Little bleeding occurred during the dissection of the cyst because a rubber tourniquet was applied to the renal pedicle. A piece of fatty tissue was placed in the cavity. Recovery was uneventful.

Postoperative intravenous pyelograms showed good results.

Scholl [4] states that peripelvic lymphatic cysts of the kidney, usually small and of little clinical importance, may become of sufficient size partially to destroy the kidney. These cysts are probably the result of lymphatic ectasia associated with obstruction of the lymphatic trunks in the hilus of the kidney. Lymphatic cysts increase the list of types and of theories concerning development of renal cysts.

Two cases were reported of lymphatic cysts which extended from the hilus to the body of the kidney and caused extensive renal damage and

3. Oddo, V. J.: Simple Cyst of the Renal Pelvis: Diagnosis and Treatment with Case Presentation, J. Urol. **59**:159-163 (Feb.) 1948.

4. Scholl, A. J.: Peripelvic Lymphatic Cysts of the Kidney, J. A. M. A. **136**: 4-7 (Jan. 3) 1948.

exerted pressure on the renal vessels. There was pronounced hypertension in both cases; removal of the cystic kidney caused a considerable drop in blood pressure in each case.

Malignant Neoplasms.—By investigation of the urine of patients with tumors of the kidney, Ludden and McDonald [5] have been able to evaluate criteria for the cytologic diagnosis of neoplasms of the kidney.

Most of the patients they have studied have had hypernephromas. This was to be expected, since approximately 85 to 90 per cent of renal tumors of clinical significance are of this type. As is well known, the cells of hypernephromas are not uniform morphologically. Usually, however, at least some of their cellular components have a clear cytoplasm and relatively large nuclei which contain prominent nucleoli. Such cells were found in urine from patients who had hypernephromas but were not found in urine from normal patients. In the authors' experience, false negative results were frequent in studies of urine obtained from patients with tumors of this type, apparently because the lesions had not invaded the renal pelvis.

Epitheliomas of the renal pelvis, which constitute about 10 per cent of renal neoplasms, present unique opportunities for the application of the urine smear technic. During the early stage of development, these tumors are almost constantly washed with urine. As is well known, prognosis is extremely poor. It is important that one factor which greatly influences prognosis, namely, rapid proliferation of malignant cells, actually facilitates diagnosis by cytologic study of the urine. This is true because of the consequent abundant desquamation of malignant cells and because of the comparative ease with which cells of rapidly proliferating epitheliomas can be recognized as malignant.

The cytologic criteria of malignancy which have been found most useful are: (1) increase in the size of nuclei in proportion to size of the cell and (2) hyperchromasia of nuclei. The shape of cells and the arrangement of their cytoplasm have been found to be of some value in the classification of malignant cells. Papillary epitheliomas tend to desquamate cells which are somewhat elongated. The cells which arise from hypernephromas, on the other hand, are more often rounded and have a vacuolated cytoplasm.

The urine smear technic has not been infallible. Two probable false positive results were obtained. Well established procedures should not be replaced by this technic, but use of the method may complement established procedures and thus aid in the early diagnosis of malignant lesions of the kidney.

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5. Ludden, T. E., and McDonald, J. R.: Diagnosis of Tumors of the Kidney by Cytologic Investigation of Urinary Sediment, Proc. Staff Meet., Mayo Clin. **22**:386-390 (Sept. 3) 1947.

Daut and McDonald [6] discuss diagnosis of malignant lesions of the urinary tract made by means of microscopic examination of centrifuged urinary sediment. At present, final diagnosis of malignant processes of the urinary tract is dependent on cystoscopy with biopsy or on the various methods of roentgenology. They undertook a study the object of which was not to supplant either of these methods of diagnosis but to present an adjunct to the methods already used to obtain diagnosis.

Methods of collection and staining used in the investigation were simple. Polychrome methylene blue was used to stain the urinary sediment of all patients suspected of having malignant lesions of the urinary tract. Since specimens last only a week to ten days, Papanicolaou's method was carried out to obtain permanence of the urinary sediment in those instances in which staining revealed malignant cells.

Pathologic aspects of diagnosis of malignant processes of the urinary tract made by means of examination of exfoliated cells may be divided according to morphology and cytology. Morphology plays a minor role, for only occasionally will the examiner see whole pieces of tissue in the urine. Commonly, however, numerous cells break off or are exfoliated in clumps. With these clumps, the opportunity for cytologic comparison is often the best.

Many possible uses of this test are obvious. Perhaps the major use is that of screening all instances of unexplained gross and microscopic hematuria, questionable renal masses or questionable lesions of the renal pelves or calices as seen in excretory urography.

Another possible application of importance is in the detection of carcinoma of the prostate gland before such a lesion is palpable through the rectum or before erosion into the urethra has occurred.

Differential diagnosis of fatty tumors, such as carcinoma of the prostate gland and hypernephroma, as opposed to tumor of the bladder at the vesical neck and epithelioma of the renal pelvis respectively, often may be possible with the use of methylene blue or sudan IV. These stains emphasize the presence or absence of fatty globules in the cytoplasm.

When this technic is used, carcinoma may be revealed, even if the results of cystoscopy or even of biopsy are negative.

In the hands of workers experienced in pathology and in other forms of cytologic diagnosis, the test is reliable. The simplicity and rapidity of the test, as well as the low cost of materials involved, should be emphasized.

There are disadvantages in the method. The test, of course, offers no guide to the extent or invasiveness of the tumor. The pathologist is

6. Dau., R. V., and McDonald, J. R.: Diagnosis of Malignant Lesions of the Urinary Tract by Means of Microscopic Examination of Centrifuged Urinary Sediment, Proc. Staff Meet., Mayo Clin. **22**:382-386 (Sept. 3) 1947.

unable to grade the tumor. The point of origin of the malignant cells cannot always be determined by this method. The possibility of error is always present.

Lownes, Baron and Lipshutz [7] add 2 cases of hemangioma of the kidney to the 43 cases previously reported. Retrograde pyelograms showed filling defects in the middle calyx of 1 patient and in the superior calyx of the other. Nephrectomies were performed because of possible tumors of the kidney. The case reports call attention to uncontrollable hematuria associated with significant absence of radiologic evidence early in the disease. Pain was a variable factor. Positive radiologic evidence was sometimes noted.

Chenery and Benson [8] report a case of cavernous hemangioma and stress the difficulty of making an accurate preoperative diagnosis. The lesions are insignificant in size and may be overlooked by the pathologist unless careful search is made of all tissue. Only 45 cases have been reported previously, but the authors of this article agree with Rottino and Mohan that the rarity of this lesion is more fancied than real and that the lesions may be the cause of many cases of so-called essential hematuria.

Esersky, Saffer, Panoff and Jacobi [9] add 3 cases of Wilms's tumor in the adult to the 54 previously reported. They review the literature and state that 80 per cent of the tumors occurred in the fourth, fifth and sixth decades. One diagnostic observation is offered: An unusually large renal mass along with a high elevation in temperature, without evidence of any noticeable urinary infection, should cause one to be suspicious of the possibility of Wilms's tumor.

Burgess [10] reports the successful removal of a Wilms tumor in a part-Hawaiian girl 3 years of age, with no evidence of recurrence at the end of three years. A full course of high voltage roentgen therapy was given beginning a week after the patient's dismissal from the hospital.

Hydronephrosis.—Beirstein [11] reports a case in which obstructive jaundice was caused by a large hydronephrotic kidney on the right side.

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7. Lownes, J. B.; Baron, S., and Lipshutz, H.: Hemangioma of the Kidney: Report of Two Cases, J. Urol. **58**:417-423 (Dec.) 1947.

8. Chenery, A. J., and Benson, A. H.: Cavernous Hemangioma of the Kidney, J. Urol. **59**:164-166 (Feb.) 1948.

9. Esersky, G. L.; Saffer, S. H.; Panoff, C. E., and Jacobi, M.: Wilms's Tumor in the Adult: Review of Literature and Report of Three Additional Cases, J. Urol. **58**:397-411 (Dec.) 1947.

10. Burgess, C. M.: Wilms's Tumor: Report of Three Year Cure, J. Urol. **58**:412-416 (Dec.) 1947.

11. Beirstein, S. S.: Obstructive Jaundice in a Case of Hydronephrosis, J. Urol. **59**:157-158 (Feb.) 1948.

The pelvis of the kidney was found adherent to the descending portion of the duodenum and to the vena cava.

Ten days after operation all evidence of jaundice had disappeared except the faint tinting of the scleras.

Varix.—Sporer and Pollock [12] report the case of a white man 62 years of age who suffered severe hematuria caused by a ruptured varix in the ureteropelvic angle. Fourteen days after nephrectomy was performed the patient died of pulmonary hemorrhage, the result of a metastatic lesion from adenocarcinoma of the stomach. The veins in the caval and portal systems were morbidly dilated, but definite venous obstruction of a major vein was not found.

Artificial Kidney.—Alwall [13] describes a new artificial kidney and discusses its advantages. It is relatively easy to handle, is small and has great dialyzing capacity. The apparatus has no movable parts except a motor-driven propeller which stirs the sodium chloride solution. A cellophane tube, through which the blood flows, is wound around a cylinder of wire netting immersed within a glass container filled with sodium chloride solution. The arterial pressure drives a thin layer of blood through the apparatus back to the vein. While the blood flows through the cellophane tube, the sodium chloride solution flows in an opposite direction through the shallows of two cylinders which rotate about fifty times each minute. This rate yields the best circulation and dialysis.

Renal Insufficiency.—Thorn [14] states that in the treatment of nephrotic edema the physician is faced with a large array of therapeutic agents, none of which appears to affect specifically the course of the underlying renal lesion. Since widespread edema, however, is a cause of prolonged invalidism per se, an attempt to induce diuresis is more than justified even though the long-range outlook may be poor. Restriction of sodium chloride, administration of urea to patients without retention of nitrogen and concentrated human serum albumin given intravenously appear to be the agents or treatment of choice. Unfortunately, the meager quantities of low salt human albumin available at present do not permit an adequate therapeutic trial in most patients. Every effort should be made to increase the supply of purified human albumin.

Treatment of chronic uremia appears to consist of (1) an intake of at least 2,500 to 3,000 cc. of fluid daily; (2) adjustment of the intake

12. Sporer, A., and Pollock, R.: Renal Varix, J. Urol. **58**:424-427 (Dec.) 1947.

13. Alwall, N.: On the Artificial Kidney: Apparatus for Dialysis of the Blood in Vivo, Acta med. Scandinav. **128**:317-325, 1947.

14. Thorn, G. W.: Treatment of Renal Insufficiency, J. Urol. **59**:119-148 (Feb.) 1948.

of sodium chloride to maintain a normal level of chloride in the serum; (3) limitation of the intake of protein to a maximum of 50 Gm. daily with a diet high in calories (carbohydrate and fat); (4) transfusions of carefully matched blood or red cells resuspended in sodium chloride or dextrose solutions; (5) intravenous administration of dextrose and infusions of sodium chloride if the level of urea nitrogen in the blood is not maintained at a satisfactory level by oral administration of fluids; (6) administration of aluminum hydroxide ("creamalin" or "amphojel") to reduce hyperphosphatemia, and (7) intravenous administration of human serum albumin for hypoproteinemia and edema.

It is essential to distinguish between hypochloremia which results from excessive loss of sodium chloride and hypochloremia which is primarily a reflection of the carbon dioxide–chloride shift. Treatment with sodium chloride is usually contraindicated in the latter.

Careful bacteriologic studies, with respect to both the type of organism and its sensitivity to the therapeutic agent of choice, are essential in treatment of infections of the urinary tract. It may be desirable to use sulfonamide compounds in combination rather than singly, and alkalinization of the urine appears to increase greatly the antibacterial action of streptomycin.

It is Thorn's opinion that the most effective treatment available today for patients with the syndrome of "lower nephron nephrosis" with intact and relatively uninvolved glomeruli lies in (1) administration of adequate whole blood to restore a normal circulating volume during the period of shock; (2) careful restriction of total fluids so that no gain in body weight is observed during the period of anuria; in most patients 1,000 to 1,500 cc. of fluid in twenty-four hours is adequate in the absence of fever or of loss of fluid from vomiting, diarrhea or other similar cause; (3) provision of as high a caloric intake as possible; during the early stage of anorexia and vomiting, infusion of a solution of 15 per cent dextrose will reduce endogenous protein breakdown; (4) use of small quantities of plasma (0.5 unit) or normal human serum albumin (10 to 15 Gm. daily) in solution of dextrose to maintain blood volume and to prevent, to some extent, excessive dissipation of fluid into the extracellular spaces; intravenous administration of albumin and plasma may reduce somewhat the breakdown of endogenous nitrogen, and (5) digitalization at the first evidence of cardiac enlargement or pulmonary congestion.

In milder cases of "lower nephron nephrosis" the renal lesions subside and the kidney opens spontaneously in five to ten days. It is usually possible to maintain patients in relatively good condition until spontaneous improvement occurs. The misconception of attempting to "flood the body" and thereby increase production of urine has no doubt

resulted in the death of many patients who otherwise would have survived.

In severer cases of "lower nephron nephrosis" it will probably become necessary after seven to ten days to relieve the body of the accumulation of waste if the patient is to survive renal damage. At this time decapsulation of the kidney, continuous gastric lavage, peritoneal irrigations or the use of the artificial kidney may be the treatment of choice. In severer cases of crush syndrome, with its relatively higher mortality rate, the early use of pressure bandages and perhaps artificial refrigeration should be considered as adjuncts to the treatment mentioned.

With the onset of diuresis, a second danger arises, namely, loss of excessive quantities of sodium chloride or, in rare instances in which there is sulfonamide intoxication, the retention of excessive quantities of these electrolytes. It is imperative to follow the serum chloride level during this period, to administer heroic quantities of sodium chloride in the first instance (sodium and chloride depletion) and to force fluids with no sodium chloride in the second (excessive sodium and chloride retention). Many deaths have no doubt occurred because of inadequate treatment at a time when satisfactory improvement of the underlying renal disease was already evident.

The concept of "lower nephron nephrosis" as a self-limited disease is essential to correct therapy. Obviously there is great danger in attempting to increase the output of urine during the oliguric or anuric phase by "flooding the body" with salt and water. Conversely, the judicious administration of sodium chloride during the diuretic phase of recovery may be a lifesaving measure.

Oliguria.—Culpepper and Findley [15] state that, important as a large variety of prerenal influences may be in precipitating urinary suppression, existing evidence favors the belief that the most important factor in maintaining the oliguric state is the appearance of tubular lesions which permit excessive reabsorption of glomerular filtrate. Little experimental, pathologic and clinical evidence has been found to support the belief that increased intrarenal pressure is a significant feature, although it may be true that decapsulation has usually been performed too late.

A review of the literature on the subject in English for the past twenty years indicates that, with the possible exception of post-transfusion anuria, decapsulation has not improved the recovery rate from anuria due to circulatory disturbances in the kidney or to toxic

15. Culpepper, W. S., and Findley, T.: Renal Decapsulation for Oliguria and Anuria, in Selected Writings by Staff Members of Ochsner Clinic, New Orleans, Alton Ochsner Medical Foundation, 1947, vol. 6, pp. 5-13.

nephrosis. On the contrary, it suggests that if decapsulation is to be done at all it should be restricted to one kidney. Much experimental work is needed on the subject of intrarenal pressure. Until this is forthcoming, decapsulation of the kidney for the relief of anuria or oliguria must be regarded as an empiric therapeutic measure of unproved value.

Hypertension and Renal Disease.—According to Sabin,[16] much experimental evidence forms the idea that interference with the circulation of one or both kidneys may result in the liberation of a pressor substance into the blood stream, with resulting hypertension. However, this pressor substance has not been successfully demonstrated in the peripheral circulation of human beings or experimental animals with hypertension.

Sabin analyzed 100 cases from the literature in which nephrectomy was performed for unilateral renal disease associated with hypertension and added 1 of his own. In 51 of the 100 cases the blood pressure returned to normal, although in 21 of these less than a year had elapsed since operation. In 23 there was a reduction in blood pressure although not to normal levels, while in 26 no improvement was obtained.

The commonest pathologic condition was chronic pyelonephritis; the kidneys frequently showed marked atrophy.

Hypertension which may be cured by nephrectomy is comparatively rare. Great care should be exercised in evaluating the functional capacity of both kidneys before operation is contemplated. Compensatory hypertrophy of the healthy kidney is a good indication of successful outcome. Generally speaking, the younger the patient and the shorter the duration of the hypertension, the better the results.

Diagnosis.—Casagrande and Merk[17] discuss renal enlargement simulating ovarian tumors.

They present 4 cases in which signs and symptoms led to the erroneous initial diagnosis of ovarian tumor. In each instance, further investigation yielded evidence of renal tumefaction. An unusually large, hydronephrotic kidney was found in each of 3 cases. In the fourth the mass was an enormous, solitary renal cyst.

Error in diagnosis may be avoided if the surgeon will keep in mind the possibility that an abdominal mass thought to be a large ovarian tumor may have its origin in the kidney.

The following diagnostic criteria, derived from an analysis of these 4 cases, may be of aid in establishing a correct diagnosis before surgical

16. Sabin, H. S.: Hypertension in Unilateral Renal Disease, J. Urol. **59**:8-20 (Jan.) 1948.

17. Casagrande, J., and Merk, H. J.: Renal Enlargement Simulating Ovarian Tumors, Brooklyn Hosp. J. **6**:19-24 (Jan.) 1948.

treatment is undertaken: A renal mass may be located more in the flank than it is in the usual situation of ovarian tumors. In none of the 4 cases could the renal tumor be palpated through the vagina. Mobility of renal masses is apt to be less than that of ovarian masses. Continuity with the kidney can occasionally be made out by palpation. Examination of the urine may or may not reveal pyuria or other evidences of renal disease. An ovary, normal in size, may be palpated on the same side as the mass. Cyclic changes in the size of the mass may be noted by the patient or physician if the lesion is of renal origin. Such changes were noted in 2 cases which proved to be examples of hydronephrosis.

Renal Displacement.—Greene [18] reports 3 cases of extreme renal displacement secondary to retroperitoneal tumor. In each instance one kidney was displaced so that in the urogram it appeared to be superimposed on the other kidney. Surprisingly, renal function was undisturbed; there was but little deformity of the pelvis and calyces. In 1 case a lipoma weighing 22 pounds (10.0 Kg.) was removed, in the second case a retroperitoneal cyst weighing 3,200 Gm. and in the third case a cyst weighing 4,800 Gm. All patients made uneventful recoveries, and the displaced kidneys returned to their nomal sites.

Perinephric Abscess.—Meads [19] states that, surgically, perinephric abscess may be classified under two heads: the primary abscess which arises from a distant focus and runs an acute course with no preexisting renal disease, and the secondary abscess which is intimately associated with an already existing renal infection. The latter type often appears insidiously under cover of the original symptoms of renal disease, which makes diagnosis difficult. A careful study of the case history will usually assist in earlier diagnosis in spite of simultaneous existence of long-standing renal symptoms. Two cases of secondary perinephric abscess are presented which emphasize these points.

ADRENAL GLAND

Neoplasm.—Bauer and Belt [20] report the cure of paroxysmal hypertension with concomitant swelling of the thyroid by surgical removal of a pheochromocytoma.

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18. Greene, L. F.: Extreme Renal Displacement Due to Retroperitoneal Tumors, J. Urol. **59**:174-178 (Feb.) 1948.

19. Meads, A. M.: Perinephric Abscess Secondary to Renal Infection, California Med. **68**:83-85 (Feb.) 1948.

20. Bauer, J., and Belt, E.: Paroxysmal Hypertension with Concomitant Swelling of the Thyroid Due to Pheochromocytoma of the Right Adrenal Gland: Cure by Surgical Removal of the Pheochromocytoma, J. Clin. Endocrinol. **7**:30-46 (Jan.) 1947.

The patient, a housewife 47 years of age, had suffered for two years from attacks which lasted from five to ten minutes. At first the attacks occurred every seven to ten days, but later they occurred much more frequently. Finally she had several attacks each day and occasionally even at night. The attacks were described as follows: There was slight pain in the stomach, legs and arms. Then nausea developed, and a swelling was felt in the neck anteriorly. The heart began to pound, and shaking, extreme weakness and fatigue were experienced, the skin became extremely pale and then red, and the lips and fingernails became blue. After such an attack the patient perspired freely and felt tired and weak. The swelling in her neck persisted for at least a half hour. The attacks usually occurred after breakfast but might occur at any time, especially when she was fatigued. She lost 7 pounds (3.2 Kg.) in weight during the two years following the onset of the attacks.

During one attack the blood pressure rose from 120 systolic and 80 diastolic to 230 systolic and 40 diastolic, with a concurrent rise in blood sugar to as much as 245 mg. per hundred cubic centimeters.

Roentgenograms taken after perirenal insufflation and intravenous administration of "diodrast" showed a tumor mass the size of a golf ball attached to the upper pole of the right kidney. At operation the eleventh and twelfth ribs were removed and a round, tense, cystic adrenal mass was exposed. It was covered with a network of distended veins. The vessels of the pedicle were ligated, one after another, and just as the base was reached the cystic mass suddenly ruptured, filling the wound with a brownish fluid containing crystalline flakes of hemosiderin. The shell of active pheochrome tissue was then lifted from its bed. During the operation, no hypertensive crisis occurred. The patient left the hospital on the tenth postoperative day. She had no further attacks, although for a time the pulse and the blood pressure showed moderate variations, which gradually subsided. The pathologist diagnosed the tissue as cystic pheochromocytoma of the adrenal gland.

The intense paroxysmal hyperemia of the thyroid gland was probably due to the sudden rise of blood pressure in the carotid sinus during the hypertensive crises.

Paroxysmal hypertension and transitory glycosuria accompanying hypertensive crises are not confined to chromaffin tumors. These conditions may occur in other diseases, and therefore do not prove the presence of a tumor.

In this case the tentative diagnosis of the tumor was based on the patient's description of her attacks, which were associated with paroxysmal arterial hypertension and hyperglycemia, and on visualization of the tumor in the roentgenogram taken by means of perirenal insufflation.

URETER

Anomaly.—Willmarth [21] reports a case of ectopic ureteral orifice within a urethral diverticulum. Review of the literature reveals 3 previously reported cases of an almost similar nature. Fromme reported a case of a supernumerary ureter opening into a urine pocket within the urethra. Day reported a case of a supernumerary right ectopic ureter which emptied into the prostatic urethra.

The case presented by Willmarth is one of a single ureter of the left kidney in a female. On examination, a small diverticulum of the urethra was found. The diagnosis was made by injecting a mixture of lubricating jelly and "skiodan" solution into the diverticulum, which could be seen to extend up the dilated, tortuous left ureter. Operation was not performed.

Transplantation.—Smith [22] tabulates the results of ureteroenterostomy in 66 patients operated on in the period 1930 through 1946. Among 47 patients with carcinoma of the bladder and 2 with treated carcinoma of the cervix there were 12 hospital deaths and 14 deaths from recurrent carcinoma. Eight died of pyelonephritis after discharge from the hospital. Among 17 patients operated on for nonmalignant conditions there were no hospital deaths and only 1 death later from pyelonephritis. Of 24 patients still living at the time of the report, 17 have satisfactory renal function, 3 show signs of renal failure and 4 have required skin ureterostomies. For at least 4 of the patients who died of pyelonephritis, renal damage by ureterostomy or nephrostomy would probably have materially prolonged life. In cases in which ureteroenterostomy has been performed, renal function should be followed by determination of nonprotein nitrogen and by the use of excretory urograms at least once a year. If the kidneys show evidence of progressive failure, nephrostomy or ureterostomy should be done.

Fortner and Kiefer [23] note that after ureteroduodenal anastomosis the kidney of the transplanted ureter continues to function in an efficient yet hyperactive manner. The physiology of the small bowel is such that almost total reabsorption of the products secreted by the kidney will result. This gives rise to a rapid increase in nonprotein nitrogen, urea nitrogen and associated products, which in turn act as physiologic stimulants so as to produce a futile increase in renal secretion. A vicious cycle is thus established which culminates in the death of the animal after nonprotein nitrogen and its associated products reach a level incompatible with life.

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21. Willmarth, C. L.: Ectopic Ureteral Orifice Within an Urethral Diverticulum: Report of a Case, J. Urol. **59**:47-49 (Jan.) 1948.

22. Smith, G. G.: Late Results of Ureteroenterostomy, Surg., Gynec. & Obst. **85**:221-227 (Aug.) 1947.

23. Fortner, J. G., and Kiefer, J. H.: Ureteroduodenal Anastomosis, J. Urol. **59**:31-37 (Jan.) 1948.

Compensatory hypersecretion of the undisturbed kidney explains the apparently undisturbed course of animals subjected to unilateral ureteroduodenostomy. The kidney of the transplanted ureter excretes its products into the small bowel, where they are reabsorbed, only to be resecreted by the undisturbed kidney in its hyperactive state. The animal is thus maintained in its normal state.

Although it produces interesting phenomena, ureteroduodenostomy is not compatible with longevity of the animal and therefore has no clinical value.

Fistula.—Caughlan [24] describes his method of correcting ureterovaginal fistula. He operated with the intention of transplanting the ureter into the bladder, but after dividing the ureter as low as possible he found it to be about 4 cm. too short for this procedure. An incision 2 cm. in width and 5 cm. in length was made in the vertex of the bladder to form a tongue. This was laid back to form a new ureter and stitched to the posterior wall of the ureter. One end of a 12 F. soft rubber catheter was passed up the ureter to the kidney; the other end was passed through the urethra. Closure was made over the catheter. Five years have elapsed since operation, and the patient has had no trouble.

Ureteral Empyema.—Ljunggren [25] reports a case of calculous pyonephrosis and hydroureteritis. After nephrectomy, the infected stump of the ureter caused or maintained an infection of the urinary tract which did not heal until the stump was removed eighteen years later.

BLADDER

Neoplasm.—Higgins [26] pleads for earlier cystectomy to prevent carcinoma from becoming inoperable or extending beyond the bladder and for operation at a time when the caliber of the ureters is such that they can be transplanted into the bowel with relatively little danger of death. Indications for cystectomy are (1) no distant metastasis as revealed by abdominal exploration, (2) carcinoma involving the floor of the bladder and ureteral orifices which, if treated locally by any method, would result in injury to ureteral orifices, loss of vesical function and incontinence, (3) extensive single or multiple infiltrating tumors, (4) multiple recurring tumors that cannot be controlled by fulguration, (5) high grade malignant tumors confined to the bladder and (6) adequate renal function.

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24. Caughlan, G. V.: Ureterovaginal Fistula: Repair of Ureteral Defect by Use of Bladder Flap, J. Urol. **58**:428-430 (Dec.) 1947.

25. Ljunggren, E.: Complications Caused by the Stump of the Ureter After Nephrectomy, J. Urol. **59**:179-181 (Feb.) 1948.

26. Higgins, C. C.: Total Cystectomy for Carcinoma of the Bladder, J. A. M. A. **135**:619-622 (Nov. 8) 1947.

Higgins prefers to transplant the right ureter into the rectosigmoid and ten to twelve days later to transplant the left ureter and extirpate the bladder. A one stage operation may be performed on a young person if renal function is satisfactory. The last twenty-two cystectomies were performed without a death. A large series must be followed for five to ten years before definite conclusions can be drawn.

Cystectomy is not the operation of choice in all cases of advanced carcinoma of the bladder, nor is it to be utilized as a last resort.

Kittredge, Henthorne and Whitehead [27] discuss tumors of the urinary tract containing glandular elements which may arise from (1) metaplasia of transitional epithelium to glandular epithelium, (2) metastasis from the intestine or other glandular organs and (3) glandular elements at the attachment of the urachus or around the vesicle neck. Four cases of glandular carcinoma are reported which illustrate the difficulty of determining whether an adenocarcinoma is primary or secondary in the bladder.

Dreiling and Hyman [28] report a case of carcinoma of the bladder treated by total cystectomy, total hysterectomy and cutaneous ureterostomy followed by secondary ureterosigmoidal implantations. The patient died thirteen months after the first operation. Necropsy showed widely disseminated carcinomatosis. The kidneys appeared normal, but sections showed chronic pyelonephritis. The ureters were markedly thickened and dilated.

Dean [29] calls attention to frequent discrepancies in the diagnosis of tumors of the bladder based on biopsy of tissue obtained through the cystoscope and on examination of the excised organ. One hundred consecutive cases in which tumors of the bladder were treated by diversion of the urinary stream and cystectomy were studied. In 58 of the 100 cases the findings on microscopic examinations of the entire bladder differed from those on examination of specimens removed through the cystoscope. Of much greater clinical significance is the fact that in at least half of all patients operated on the grade of malignancy was greater than the cystoscopic biopsy indicated. Unfortunately, preoperative pathologic examinations frequently have provided such misleading data that the true nature of the growth remains uncer-

27. Kittredge, W. E.; Henthorne, J. C., and Whitehead, M.: Glandular Metaplastic Malignancy in the Urinary Tract: Report of Four Cases, J. Urol. **58**:282-288 (Oct.) 1947.

28. Dreiling, D. A., and Hyman, A.: Hysterectomy and Total Cystectomy with Bilateral Ureterocutaneous Implantation for Carcinoma of the Bladder: Secondary Ureterosigmoidal Anastomosis for Complicating Ureterovaginal Fistula, J. Urol. **58**:435-440 (Dec.) 1947.

29. Dean, A. L.: Comparison of the Malignancy of Bladder Tumors as Shown by the Cystoscopic Biopsy and Subsequent Examination of the Entire Excised Organ, J. Urol. **59**:193-194 (Feb.) 1948.

tain. In a considerably smaller but yet a substantial proportion of cases even direct observation and palpation of the exposed bladder have failed to demonstrate the full extent of the disease. Until such a time, therefore, as more exact examinations are devised, successful treatment of tumors of the bladder depends, as it always has, on mature clinical judgment.

Diverticulum.—Spence and Baird [30] in a review of the records of 35 patients with vesical diverticula find that the best treatment is diverticulectomy together with correction of obstruction of the neck of the bladder by transurethral resection or prostatectomy. They are of the opinion that diverticulectomy has been a neglected operation and should be performed as a primary procedure whenever retention in the diverticulum is demonstrated irrespective of the size of the sac. The authors' technic in the case of a large adherent diverticulum is (1) to open and explore the bladder, (2) to place a finger through the orifice of the diverticulum, (3) to expose and sever the neck of the sac extravesically and (4) immediately to separate the diverticulum from the bladder. The opening in the bladder is closed from without. The mucosal lining is removed from the diverticulum in a manner described by Barnes and Pearson. Smaller sacs are removed intravesically by eversion and amputation. Diverticulectomy was performed in 9 cases, with subsequent transurethral resection in 3 and enucleation in 3. Eight patients were treated by transurethral resection of the diverticulum alone; 1 of these was a woman. In 9 patients the urethra was dilated, with results varying from good to poor. In 5 patients suprapubic cystotomy was performed for drainage because of sepsis, uremia and poor general condition; in 4 cases there was no treatment.

Stone.—Maslow and Garnello [31] report the successful removal of a vesical calculus weighing 392 Gm. with the Simpson obstetric forceps. At the same operation two smaller calculi were removed from the distal right ureter. The patient recovered.

Rupture.—Tool [32] reports a compound fracture of the pelvis accompanied with intraperitoneal rupture of the urinary bladder in a girl 15 years of age. The patient died three and a half days after the accident. A review of the recent literature discloses only 5 similar cases. In 3 of these trauma was accompanied with fracture of the pelvis. In the female the bladder is largely extraperitoneal unless dis-

30. Spence, H. M., and Baird, S. S.: Vesical Diverticula: A Clinical Study with Special Reference to Treatment, J. Urol. **57**:327-343 (Nov.) 1947.

31. Maslow, L. A., and Garnello, J.: Giant Bladder Calculus Associated with Upper Urinary Tract Lithiasis: Case Report, J. Urol. **58**:441-443 (Dec.) 1947.

32. Tool, C. D.: Intraperitoneal Rupture of the Urinary Bladder in the Female: Report of a Case, J. Urol. **58**:431-434 (Dec.) 1947.

tended or lifted out of the pelvis by a gravid uterus. For this reason intraperitoneal rupture is exceedingly rare.

Thrush Infection.—Sauer and Metzner [33] state that thrush infection of the urinary bladder, although uncommon, may occur more often than the literature would indicate. Diagnosis of this disease may easily be missed because its occurrence is not generally known. Recognition is possible only if the disease is suspected, and close cooperation between the bacteriologist and the urologist is essential. Monilia albicans does not grow in ordinary culture mediums, and it is imperative to request specific cultures for the Monilia fungus since diagnosis of thrush infection is dependent on identification of the fungus.

As to the mode of infection, it may be assumed that the organisms invade the bladder by way of the urethra from the vagina, where thrush infection occurs not infrequently. By way of illustration, Monilia albicans was identified in the catheterized specimen of urine from a patient with severe and persistent thrush infection of the vagina. Cystoscopic examination was refused by the patient because there were no urinary symptoms.

It is always advisable to request culture for Monilia albicans if whitish, curdled membranes of unexplained origin are discovered on cystoscopic examination, particularly if no response to therapy is obtained.

However, if the organisms cannot be identified on repeated cultures, one should be reluctant to make a diagnosis which would then be based on the cytoscopic appearance of the lesions alone. Certain types of carcinoma of the bladder, chronic ulcerations following roentgen or radium irradiation, malakoplakia and chronic ulcerative alkaline cystitis may present similar lesions, at least temporarily. Prolonged observation and repeated biopsies in such cases will usually reveal the nature of the disease.

The prognosis for thrush infection of the urinary tract does not seem to be favorable. It is apparent that the treatment employed resulted in rapid destruction of the Monilia fungus in the urine and in the superficial layers of membranes. Presumably, the organisms remain viable in the deeper layers of the bladder wall, where they cannot be reached by various disinfecting solutions. The resistance of Monilia albicans to large doses of penicillin and streptomycin is noteworthy.

Analine Dye Cystitis.—Lyons [34] reports 6 cases of poisoning by 5 chloro-ortho-toluidine, a toxic analine dye that enters the body by

33. Sauer, H. R., and Metzner, W. R. T.: Thrush Infection of the Urinary Bladder, J. Urol. **59**:38-41 (Jan.) 1948.

34. Lyons, J. S.: Hematuria in Workmen in Aniline Dye Industry Due to 5-Chloro-Ortho-Toluidine: Six Case Reports, J. Urol. **58**:277-281 (Oct.) 1947

inhalation or by absorption through the skin. He describes the clinical course and the cystoscopic findings in these cases. Dysuria, frequency and hematuria occurred a few hours after absorption of the chemical. Cystoscopy revealed an acute hemorrhagic cystitis, with exfoliation of the superficial layers of the mucosa. Recovery was complete in three weeks, and the examination at the end of three months showed a normal urologic tract. The dye has a specific toxic action on the urinary bladder which causes immediate damage on first contact.

PROSTATE

Hypertrophy.—Donovan [35] reports 10 cases of severe anemia of unexplained origin which occurred in patients who had chronic retention from prostatic obstruction. Blood counts of 3,000,000 red cells or less, a raised blood pressure and persistently high concentrations of urea in the blood were found in all patients. The anemia was probably the result of disordered or diminished production of blood caused by retention of nitrogen; transfusion may or may not raise the count. Recovery in all cases was slow and incomplete. The triple syndrome warrants early recognition of the need for prolonged suprapubic drainage.

Kretschmer and Butler [36] report a series of 314 cases of prostatic obstruction in 112, or 35.67 per cent, of which heart disease was evident either clinically or in the electrocardiogram. In many cases more than one cardiac lesion was present. Nineteen patients were in congestive heart failure when admitted to the hospital. Forty-five showed enlarged hearts, 35 had hypertensive cardiovascular disease and 2 had cardiovascular renal disease. Eight patients had aortic insufficiency, and 8 had aortic stenosis. Nine had mitral stenosis and 39 mitral insufficiency. Three had aortic stenosis with mitral insufficiency, while 12 patients gave a definite history of attacks of angina. After proper cardiac management, the obstruction at the neck of the bladder was relieved by transurethral resection.

There were 6 deaths, a mortality of 1.9 per cent, with only 1 death due to heart disease. This occurred on the tenth day after resection, the day scheduled for the patient's discharge from the hospital, and was due to coronary thrombosis. The second death, from pulmonary embolism, occurred on the fifteenth postoperative day, the day scheduled for the patient's discharge from the hospital. The third death occurred because of complete suppression of urine on the sixteenth day after resection. At necropsy both ureters were found completely occluded by

35. Donovan, H.: Severe Anaemia and Hyperpiesia Associated with Prostatic Obstruction, Brit. J. Urol. **19**:126-130 (Sept.) 1947.

36. Kretschmer, H. L., and Butler, S.: Prostatic Surgery and Heart Disease, J. A. M. A. **136**:441-444 (Feb. 14) 1948.

carcinoma which had metastasized from the rectum. There were 2 deaths due to aspiration of gastric contents into the lungs, a clinical entity overlooked for many years and recently brought to light by Irons and Apfelbach. The sixth death was due to severe urinary infection with secondary hemorrhage, septic manifestations and terminal pneumonia.

The prognosis concerning the cardiac patient with prostatic obstruction is good, provided that the condition is recognized before operation and proper treatment is instituted. The low mortality rate and relief of the condition have been made possible for the following reasons: (1) careful preliminary study and treatment of the cardiac condition; (2) the fact that transurethral resection is a less formidable procedure than suprapubic or perineal prostatectomy; (3) the use of modern methods of anesthesia; (4) the use of blood transfusions, and (5) the possibility of getting these patients out of bed the next day after operation when this may be necessary.

Rees [37] reviews a series of 643 cases of benign prostatic enlargement. Five hundred and eighty-nine patients had been operated on, with 88 deaths. Necropsy was done in 64 cases. Suprapubic drainage was performed on 106 patients, with 30 deaths (28 per cent), transurethral resection on 137, with 9 deaths (6.5 per cent), one stage suprapubic enucleation on 104, with 12 deaths (11.5 per cent), two stage suprapubic enucleation on 158, with 13 deaths (8 per cent) and perineal prostatectomy on 45, with 4 deaths (9 per cent). Severe sepsis in the urinary tract was either the cause of death or the direct contributory factor in 38 cases. The second commonest cause of death was pulmonary embolism.

McCrea [38] discusses his technic of vesical sump drainage and its advantages in 100 consecutive, unselected cases of enlarged prostate. With the exception of 2 instances, the single stage suprapubic prostatectomy was routinely followed. Preoperative drainage was successfully maintained by an indwelling urethral catheter. It is believed that the one stage procedure is to be preferred to the two stage procedure. Not only does the one stage procedure permit the patient to be ambulatory, but also it is believed that healing of the wound is more secure than the healing which follows the two stage procedure. It is further believed that danger of incisional hernia is less in the one stage procedure, as the edges of the fascia may be approximated more readily.

The average age was 67.1 years: the youngest patient was 56 years of age and the oldest 81 years. There were 4 deaths, 3 of which were

37. Rees, W. S.: Causes of Death in Senile Benign Prostatic Enlargement, Brit. J. Urol. **19**:83-84 (June) 1947.

38. McCrea, L. E.: Sump Drainage in Suprapubic Prostatectomy: A Survey of One Hundred Consecutive, Unselected Cases, J. Urol. **59**:207-210 (Feb.) 1948.

caused by cardiac disease; the fourth was due to pneumonia. In a recent survey, it was found that the average stay in the hospital after operation was 32.6 days when rubber tube drainage was used; with sump drainage in uncomplicated cases, it was usually 11 to 13 days. In many cases, cardiac or renal complications impeded normal convalescence. As a result, the average time of hospitalization for all cases was found to be 18.5 days.

The degree of comfort offered to patients by sump drainage is amazing. To be dry and comfortable during convalescence is ideal for the patient and for the nursing staff. The reduction in the occurrence of pneumonia and pyelonephritis is interesting. In a recent survey of 58 cases in which deaths occurred after prostatectomy and in which rubber tube drainage was used, it was found that pyelonephritis caused 15.5 per cent of the deaths and pneumonia 10.3 per cent. In McCrea's series there was not a single instance of pyelonephritis and there was only 1 death from pneumonia. The patient is never chilled by a wet dressing or a wet bed. The wound heals rapidly by primary intention except for the small area utilized by the sump drain. Infection within the space of Retzius has never occurred. Necrosis along the fascial planes, so common when rubber tube drainage is used, occurred on only one occasion. The one disadvantage of sump drainage is that the mechanical contrivance must be understood by the intern and the nursing staff. Unless the principles of management of this type of equipment are understood, the use of sump drainage will be attended with dissatisfaction. McCrea describes in detail the vesical sump drain and motor.

Abeshouse [39] gives an analysis of 18 cases of heterotopic bone formation following suprapubic prostatectomy. The new bone formation is found in three different parts of the wound, namely, (1) in the scar, (2) in the deep fascial tissue of rectus sheath and (3) in the new connective tissue or granulation tissue surrounding the suprapubic fistula. In some instances the new bone is attached to the pubic bone.

The size of the osseous growth varies from small spicules or flakes of bone in the perifistulous type to large, oval or triangular flat plates of bone which occur in the deeper tissues and extend the length of the incision.

The time elapsing before the osseous growth is detected by palpation or operation varies from twenty-one days to fourteen years. The maximal growth of the bony mass occurs within one to two months after the initial suprapubic operation and then remains stationary.

Diagnosis is usually made by palpation and confirmed by roentgenographic examination in cases in which there are large bony growths.

39. Abeshouse, B. S.: Heterotopic Bone Formation Following Suprapubic Prostatectomy, J. Urol. **59**:50-66 (Jan.) 1948.

The small bony spicules found in the perifistulous tissues are seldom recognized clinically but are detected at operation.

Heterotopic formation of bone must be differentiated from (1) foreign body in the wound, (2) osteitis of the pubic bone, (3) hematoma of the rectus muscle, (4) neoplasms of the pubic bone, (5) tumors of the muscle, (6) interstitial syphilitic myositis, (7) exostosis of pubic bone, (8) congenital osteoma cutis and (9) calcification or ossification of a primary malignant or secondary metastatic tumor in this area.

From a pathologic standpoint, the heterotopic bone is true cancellous bone. Histologic studies show all the transitional stages, from fibrillary connective tissue stroma, cartilage cells and haversian canals to true bone cells.

The most likely explanation of the new bone formation is the metaplasia of the connective tissue cells into bone cells. The osteogenetic process is dependent on (1) ossifying fibrocytes and (2) proper environmental changes.

The predisposing factors initiating the metaplastic process have not been clearly defined or established. An inflammatory process in the space of Retzius and adjacent tissue and a suprapubic tube may serve as irritative agents.

Lubin, Fetter and Erf [40] report a case of monocytic leukemia, which appeared to be a case of obstructing prostate, in a white man 56 years of age. For ten years he had suffered from nocturia, frequency, small stream and acute attacks of retention of urine. Six months before entering the hospital the patient had resorted to self catheterization.

On his admission the temperature was 100 F., the prostate greatly enlarged, the right testis swollen and tender, the seminal vesicles indurated and the gingivae slightly infected. An attempted cystoscopy on the ninth day and a transurethral resection on the twenty-third day were unsuccessful because of an elongated urethra. A few sections of tissue were taken from the prostate for biopsy. Bleeding was profuse; it was controlled by packing after cystotomy was performed. The incision was permitted to heal by primary intention without further regard of the obstruction of the vesical neck. The patient left the hospital on the seventeenth postoperative day. His temperature was 100 F., and there were pain and tenderness in the right flank. His condition was diagnosed as subacute monocytic leukemia. He died about twenty-three days later.

The diagnosis of monocytic leukemia was made from repeated peripheral blood counts. On the basis of the urinary symptoms and the concomitant gingivitis, the authors estimate the duration of the disease as approximately nine months.

40. Lubin, E. N.; Fetter, T. R., and Erf, L. A.: Subacute Monocytic Leukemia Presenting Symptoms of Prostatism: A Case Report, J. Urol. **58**:272-276 (Oct.) 1947.

Histologic examination of the resected prostatic tissue showed moderate hyperplasia, with considerable round cell infiltration which could not be differentiated "due to distilled water distortion."

In 1940 Flaherty, Cope and Shecket reported a case of prostatic obstruction as the presenting symptom of acute monocytic leukemia. Their patient was 38 years of age. From the first symptom of frequency to the time of acute urinary obstruction only seven days elapsed. The patient died forty-eight days after the onset of urinary symptoms. Distinctive large cells were found not only in the prostate but also in the bladder wall, kidneys, ureters, liver, heart, lymphatic vessels and many other tissues. Leukemic cells may infiltrate any organ but rarely in sufficient numbers to be the only cause of prostatic enlargement in a man 56 years of age who has had urinary difficulties for ten years.

Dees, Steward, Meares and Orr [41] report a modified irrigating solution of glucose and insulin for use in transurethral prostatic resections. One unit of crystalline zinc insulin was added to 4 Gm. of glucose. Preliminary determinations of blood sugar content were made on all patients immediately before the administration of the spinal anesthetic. Further determinations of blood sugar content were made every fifteen minutes during the operative procedure and thirty and sixty minutes after discontinuance of the use of the irrigating solution. In none of the patients was there a pronounced rise in the level of blood sugar, and in only 1 was there a moderate rise. One hour after operation the blood sugar content in all patients was at a satisfactory level The patient in whom the greatest rise in blood sugar occurred had worn a suprapubic catheter nine months before resection. Preliminary cystoscopy showed a greatly infected bladder with many areas of frank ulceration. During resection bleeding was profuse and difficult to control. The comparatively significant rise in concentration of blood sugar was thought to be due to a combination of several factors, i. e., greatly increased intravesical pressure due to vigorous irrigation incident to the attempt to control bleeding, prolongation of operative procedure and increased absorption through multiple bleeding points and ulcerated areas.

Malignant Neoplasms.—Colston and Brendler [42] state that endocrine therapy in the treatment of carcinoma of the prostate, either by administration of estrogen or by orchiectomy or by a combination of the two, has been proved by many competent observers to have a definite and most valuable place. Regression of the primary growth, as measured

41. Dees, T. A.; Steward, W. D.; Meares, E. F., and Orr, L. M.: Modified Irrigating Solution for Transurethral Prostatic Resections: A Preliminary Report, J. Urol. **59**:212-214 (Feb.) 1948.

42. Colston, J. A. C., and Brendler, H.: Endocrine Therapy in Carcinoma of the Prostate, J. A. M. A, **134**:848-853 (July 5) 1947.

by rectal examination, has been noted to occur in approximately 75 per cent of the cases and regression of metastatic lesions in 45 per cent.

This regression of the prostatic growth led Colston and Brendler to follow a series of 7 cases in which on first examination the growth was considered too far advanced for complete extirpation by radical operation. It was considered that the regression of the neoplasm, as far as could be judged by rectal palpation, had progressed to a sufficient degree after endocrine therapy to permit the radical operation, which was carried out successfully. There has been no operative mortality in this series, but in 2 cases complications resulted from the formation of strictures at the site of the anastomosis. One patient died of recurrence and metastasis one year after operation.

The patients in this series have all been operated on within the last two years, so that the presentation is in no sense intended as a study of ultimate mortality. It is hoped that five year cures will be obtained in some of the cases in which, on physical examination, the observer's opinion was that the prognosis for radical cure was unfavorable.

Regression of the growth, which usually occurs, materially facilitates the operative technic in moderately advanced cases.

Endocrine therapy for the preparation of patients to undergo radical operation is believed to be of utmost value. In view of the regression of the primary growth which usually occurs in carcinoma of the prostate after endocrine therapy and which is attributed to the death of at least some of the malignant cells, presumably at the periphery of the lesion, it would seem advisable to institute endocrine therapy in all cases of carcinoma of the prostate, even in those in which the criteria for the radical operation are fulfilled.

Deming and Hovenanian [43] report the preparation of a series of heterologous growths from a prostatic cancer of the adenocarcinomatous type from a human being. The lesion reproduced itself without the influence of any foreign carcinogenic agent through successive generations in male and female guinea pigs. Transplants were made from one animal to another through ten generations without selection of animals with regard to strains relative to the susceptibility to cancer. The cancerous prostatic tissue was obtained from a man 69 years of age who had metastatic lesions in the lumbar vertebrae and the left vas deferens. In all generations 94 male and 28 female animals were inoculated; heterologous transplants were successful in 43.6 per cent of the males and in 11.3 per cent of the females.

Throughout all the generations of transfer the cellular structure seen in the parent human tumor was maintained. In the first two generations

43. Deming, C. L., and Hovenanian, M. S.: The Hormonal Factor in Heterologous Growths of Human Prostatic Cancer, J. Urol. **59**:215-219 (Feb.) 1948.

cancerous tissue grew in the anterior chamber of the eye in about 75 per cent of the males; in 3 of the female animals the transplanted tissue remained alive for about ten days and then disappeared. In the first five generations of the female animals the tissue from the transplanted prostatic cancer did not grow, which seemed to establish the fact that prostatic cancer requires the male hormone, androgen, for its growth. In the sixth generation 1 female was given 5 mg. of androgen on the day of transplant and daily for thirty-five days thereafter. The cancer grew rapidly in this animal.

In the eighth generation tumors grew in 50 per cent of both males and females. These females were untreated, which showed that the tumor had now become feminized and would grow in the female animal without excessive androgen stimulation. Transfers were made into male and female mice, which accepted the tissue and produced the cancer growth readily; this indicated that the tumor had become independent of both male and female hormones. In the tenth generation tumors grew in about 40 per cent of males and females, which again emphasized the fact that the tumor probably was influenced little by male and female hormones. The possibility of its becoming resistant to estrogen seemed plausible in this phase of the experiment.

These experiences indicate that heterologous growths of human prostatic cancer respond to hormonal therapy, although in about 20 per cent of cases prostatic cancer in human beings does not respond to castration or to estrogen therapy because of the production of androgen in the adrenal gland. The behavior of heterologous growths seems to indicate that, in addition to production of androgen by the adrenal gland, prostatic cancer reaches a phase in which it is refractory to estrogen, thereby emphasizing the independence and autonomy of the tumor. Thousands of patients respond favorably for varying periods after hormonal treatment and subsequently die of cancer regardless of castration and estrogen therapy. There is no doubt that androgen is a factor in the production of prostatic cancer or the activating agent in its growth.

Equally, it is evident from these experiments that estrogen is an inhibitor of this cancerous growth because cancer could not be grown in the female animal until the eighth generation or until the cancer had become tolerant of the estrogen factor. If full control of the growth can be obtained by hormonal therapy, then as much of the androgen factor as possible must be eradicated by castration and the administration of large amounts of estrogen. Hormonal treatment should be instituted as early as possible in cases of inoperable prostatic cancer or as soon as a histologic diagnosis is obtained. Sporadic cases may be controlled if a "knockout" hormonal influence is applied. In general, cure cannot be expected if the physician sees the patient only when the

disease is in the late stages of development and then treats it with homeopathic doses of estrogen. Thus hormonal therapy in cases of inoperable cancer of the prostate is most effective when (1) it is given early and (2) castration is combined with the administration of large doses of estrogen.

Landsteiner and Brown [44] present a study of 35 cases of carcinoma of the prostate in which the patients were treated by orchiectomy. Twelve of 23 patients with metastasis died within twenty-eight months, and 11 are living at the time of the report; the longest period of survival since operation to the time of writing is twenty-five months. Of 11 patients without metastasis, 5 are living; the longest period of survival after operation is thirty months.

Notable relief was experienced within forty-eight hours by half of the patients who suffered pain and slight to moderate relief by the others. Improvement in well-being and appetite paralleled relief of pain in almost all instances.

After orchiectomy, bony metastasis showed increased density and became more discrete in the majority of instances and sometimes also increased in extent.

A decrease in size and softening of the original lesion were observed in a number of cases after operation, but improvement in urinary function attributable to orchiectomy alone occurred in only a few cases, and it was necessary to perform other operations to free the vesical outlet in 22 patients.

Wattenberg [45] observes that repeated injections of estrogens or diethylstilbestrol for long periods caused regression of prostatic carcinoma as well as hyperossification about the regressed tumor cells. Illustrations are included of a metastatic lesion taken from the pubic bone before and after administration of diethylstilbestrol and orchiectomy. Before treatment most of the cells of the prostatic cancer were in acini. The cytoplasm of the cells was foamy; the nuclei were large and round and contained rounded vacuoles. The use of diethylstilbestrol caused the cytoplasm to regress, and the nuclei became smaller, irregular and pyknotic and were without definite arrangement. In some areas there were no nuclei and only cell remnants were seen.

Culver and Baker [46] discuss carcinoma of the prostate and report 16 cases in detail. The article includes eleven good illustrations.

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44. Landsteiner, E. K., and Brown, H. P.: Observations on the Treatment of Carcinoma of the Prostate by Orchidectomy, Am. J. M. Sc. **213**:450-455 (April) 1947.

45. Wattenberg, C. A.: Bone Changes and Variations in Skeletal Metastases Due to Diethylstilbestrol and Orchiectomy During Treatment of Cancer of the Prostate, J. Urol. **58**:378-383 (Nov.) 1947.

46. Culver, H., and Baker, W. J.: Carcinoma of the Prostate Gland, Illinois M. J. **92**:282-292 (Nov.) 1947.

Perineal biopsies were performed in 11 cases. Adenocarcinoma was found in 8, and in most instances a radical prostatovesiculectomy was performed. One patient was alive at the end of ten years, 2 at the end of five years, 1 at the end of four years and 4 at the end of two years. Other patients with carcinoma of the prostate underwent either two stage suprapubic prostatectomy or transurethral resections.

No standard method of treatment can be advised because the findings and symptoms are so different in each patient. The patient with far advanced carcinoma should be given the benefit of immediate orchiectomy. On the other hand, estrogens provide relief for a large group of patients with or without local pain. If obstruction continues, transurethral resection is indicated, but many patients get relief from treatment with estrogens alone. However, some do not react favorably to the hormone, and others eventually lose the early clinical effect. Two to 3 mg. of estrogen is a maintenance dose. Larger doses cause painful,

TABLE 2.—*Duration of Life of Patients With Cancer of the Prostate*

	Not Castrated	Castrated
Cases	75	75
Years studied	1933 to 1938	1941 to 1947
Alive after treatment		
1 year	62	70
2 years	32	47
3 years	14	26
4 years	4	10
5 years	2	8
6 years	1	6

enlarged breasts, edema of the ankles and gastrointestinal disturbances. Unfortunately, it has been observed repeatedly that metastasis occurs after orchiectomy or during the administration of estrogens in any dosage.

Neuswanger [47] states that a ten year survey in Connecticut shows that cancer of the prostate accounts for 10 per cent of cases of cancer in the male and for 4.5 per cent of all cases of cancer. Of 150 patients studied, only 2 were suitable for radical operation. Among 75 consecutive patients treated by castration the symptoms in 8 were definitely aggravated, but compared with an equal number of patients not treated by castration these patients had a definite increase in length of life (table 2).

Castration is probably the best treatment for advanced carcinoma of the prostate, but it is not an ultimate cure. It relieves symptoms, permits gain in weight, prolongs life and saves hospital and medical care, and many patients are able to return to useful life.

47. Neuswanger, C. H.: Cancer of the Prostate, Connecticut M. J. **11**:813-814 (Oct.) 1947.

Syphilis.—Crowley and Thomas [48] report a case of syphilitic gumma of the prostate and emphasize the rarity of this condition as proved by histologic study. Theirs is the first patient to be submitted to an extensive transurethral resection of the prostate and the first in whom the tissue shows gummatous lesions with caseation. Spirochetes could not be demonstrated. However, the history of the patient, a white man 53 years of age, gave evidence of the presence of syphilis. The prostate was moderately enlarged, stony hard, fixed and nodular but painless to deep palpation through the rectum. Syphilis of the prostate should be suspected in all syphilitic patients who present symptoms of obstruction of the vesical neck and signs which ordinarily are suggestive of carcinoma of the prostate. Antisyphilitic treatment should be continued until the prostate gland returns to normal consistency and satisfactory results of serologic tests are obtained.

GENITOURINARY TRACT IN GENERAL

Urinary Antisepsis.—Carroll, Allen and Doubly [49] present the results of a clinical and laboratory study of 39 patients with persistent infections caused by Pseudomonas aeruginosa and related organisms. Fairly reliable information concerning the most suitable drug and the optimal dose in a given infection can be obtained by in vitro sensitivity tests, and it is recommended that these be more routinely adopted in medical practice. Mandelic acid and streptomycin have been found to be the most effective drugs in the treatment of infections caused by Ps. aeruginosa. Penicillin and the sulfonamide compounds are relatively ineffective. Streptomycin is most effective if the urine is alkaline, whereas mandelic acid requires an acid urine. Increased resistance of organisms to streptomycin therapy is probably due to the emergence of resistant strains. It is necessary, therefore, to determine the susceptibility of the infecting organisms and to administer initial doses sufficient to control the infection rapidly. If resistance to bacteria is permitted to develop after an inadequate dose or improper p_H, even greatly increased doses may fail to control the infection.

Everett, Vosberg and Davis [50] find phthalylsulfathiazole ("sulfathaladine") effective in the treatment of urinary infections due to Escherichia coli. Administration of the drug in appropriate doses, approximately 0.1 Gm. per kilogram of body weight daily, usually renders

48. Crowley, E., and Thomas, E.: Syphilis of the Prostate: Report of Case and Review of Literature, J. Urol. **58**:367-371 (Nov.) 1947.

49. Carroll, G.; Allen, H. N., and Doubly, E. K.: Study of Bacillary Infections of the Urinary Tract, J. A. M. A. **135**:683-686 (Nov. 15) 1947.

50. Everett, H. S.; Vosberg, G. A., and Davis, J. M.: The Treatment of E. Coli Urinary Infections with Sulfathaladine (Phthalylsulfathiazole), J. Urol. **59**:83-91 (Jan.) 1948.

the urine sterile by the end of one week. Continued use of the drug for two additional weeks furnishes greater protection against recurrence of infection. The drug has proved effective against infections which were resistant to other sulfonamide compounds. It is not effective bacteriologically against organisms other than E. coli. It is tolerated well by patients with anemia, leukopenia, or low renal function, who ordinarily do not tolerate other sulfonamide drugs well. "Sulfathaladine" has been administered to at least 1 patient throughout five months of pregnancy, without demonstrable harmful effects.

Narins [51] used a new sulfonamide (NU-445) in 50 consecutive cases of infections of the urinary tract due to Bacillus coli or Bacillus proteus or both. Twenty-four patients received a total daily dose of 6 Gm., and 26 were given 8 Gm. a day. In most instances the period of treatment was twelve days or less. To satisfy the criteria for cure, sterile cultures were required for at least two weeks after cessation of treatment. Clinical improvement without bacteriologic cure was not counted as a positive response. Infections due to B. coli responded more readily to NU-445 than did infections due to B. proteus. The larger dose proved to be more effective. Best results were obtained in uncomplicated cases of acute or chronic cystitis or pyelonephritis not requiring prolonged drainage involving a foreign body. The new drug is tolerated well; there is freedom from crystalluria and from consequent damage to the urinary tract.

In view of this and because of its apparent effectiveness against infections due to B. coli and B. proteus, NU-445 represents a useful addition to the various chemotherapeutic agents available for the treatment of infections of the urinary tract.

An analysis and evaluation of the effects of streptomycin in a series of 15 cases of urologic infection has been made by Bandler, Roen and Mulaire.[52] The antibiotic streptomycin is a valuable addition to the urologic drugs now in existence. Instances have been presented in which the chemotherapeutic and antibiotic agents ordinarily used have been inadequate and streptomycin apparently has proved to be lifesaving.

If an organism is susceptible to the action of streptomycin, the urine may be completely sterilized. Failure to correct underlying pathologic lesions, such as obstructive factors, is definitely responsible for the recurrence of infection following streptomycin therapy and may be a factor in the development of bacterial resistance to this antibiotic agent.

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51. Narins, L.: The Treatment of Bacillus Coli and Bacillus Proteus Infections of the Urinary Tract with a New Sulfonamide (NU-445), J. Urol. **59**:92-95 (Jan.) 1948.

52. Bandler, C. G.; Roen, P. R., and Mulaire, V. J.: Streptomycin in Genitourinary Infections, J. Urol. **59**:96-110 (Jan.) 1948.

In the presence of a foreign body such as a calculus or a nephrostomy tube renal infection may be eliminated temporarily by the use of streptomycin if the offending organism is susceptible to this antibiotic. However, there soon is recurrence of the same organisms.

In vitro tests of susceptibility of an organism to streptomycin cannot always be relied on to determine its effect in the patient. In some cases in which there have been pronounced febrile reactions it has been observed that after the administration of streptomycin there has been clinical improvement despite the fact that bacterial cultures of urine still yielded the organisms. This would indicate that streptomycin has perhaps been effective in altering the pathogenicity of the organisms. Whether the change is qualitative or quantitative has not been determined.

In cases of nonspecific prostatitis it is possible to free the prostatic secretions of pathogenic bacteria for brief periods; however, so far as the clinical findings and subjective symptoms are concerned, streptomycin does not change the course of this disease entity.

The streptomycin now available has definite neurotoxic properties. In this series of 15 cases of urologic infections there were 2 cases of toxic labyrinthitis and 1 case of involvement of the left recurrent laryngeal nerve after its use. In a fourth case there was mild and transitory involvement of the facial nerve. This is an incidence of toxic reactions of more than 25 per cent. In view of the potential toxicity of streptomycin, its prophylactic use in cases in which urologic operations are performed should not be indiscriminate.

Lazarus, Marks and Schwarz [53] report 15 cases of infection of the urinary tract due to Bacillus pyocyaneus, in 5 of which the infection was due to the mucoid variant and in 10 to the nonmucoid strains. Streptomycin in varying doses was administered to all patients in the former group and to 6 in the latter. Effective destruction of the organism occurred in 2 patients infected with the mucoid strain; 1 patient with a positive blood culture responded to administration of 20 Gm., and the other, after removal of a calculous pyonephrotic kidney, responded to 13 Gm. of the antibiotic. Streptomycin was administered to 6 patients in the group of 10 affected by the nonmucoid strain of B. pyocyaneus, and in 3 complete resistance to the antibiotic occurred. Although the organism was apparently destroyed in the other 3, a permanent cure is uncertain because the organism is known to recur. Examinations of cultures of the urine at frequent intervals are indispensable in determining permanency of cure in urinary infections due to B. pyocyaneus.

53. Lazarus, J. A.; Marks, M. S., and Schwarz, L. H.: Pyocyaneus Infections of the Urogenital Tract with Special Reference to Streptomycin Therapy, J. Urol. **59**:243-251 (Feb.) 1948.

Although streptomycin cannot be considered a specific remedy in most instances, it still shows sufficient merit to warrant its use in large doses.

Slotkin [54] makes a preliminary report of a new and rapid method for the control of urinary tuberculosis. Six patients with inoperable, bilateral renal tuberculosis with secondary symptoms referable to the bladder were given intramuscular injections of chaulmoogra oil and streptomycin. Each patient received 1 cc. of the oil daily for three days and then 2 cc. for four days. From the seventh day the patient received 1 cc. of oil and 1 Gm. of streptomycin for thirty days. The Mycobacterium tuberculosis has a protective cell wall which appears to to be dissolved by the chaulmoogra oil. Each patient treated improved spectacularly, and tubercle bacilli could not be demonstrated by clinical, bacteriologic or cultural studies.

Cellulose Gauze.—Goldstein and Hollander [55] report their experience with oxidized cellulose gauze ("oxycel") used as a hemostatic pack in 59 urologic cases. The hemostatic property of this gauze is most dependable when it can be given constant supportive pressure; thus, in the kidney it should be reinforced with a mattress suture, and in the suprapubic prostatic fossa it should have a regular gauze pack behind it. The perineal closure should be strong enough to give it support. The gauze becomes black when it touches blood and is quickly converted into a soft, amorphous mass. Within twenty-four hours, this mass has begun to disintegrate into large and small granules. These drain from the body through the nearest exit, which may be either the urinary tract or the wound itself. The possibility of disruption of the wound and formation of a fistulous tract is increased, because the oxidized cellulose gauze retards complete healing. After suprapubic prostatectomies the granules are discharged through the urinary tract and the wound. Until they are completely drained from the urethra or are mechanically removed with a sound and with sodium bicarbonate, they act as obstructions and delay voiding. Goldstein and Hollander report postoperative hemorrhage in 3 cases even with the use of this oxidized cellulose gauze.

Genital Anomalies.—Spence and Baird [56] state that genital abnormalities of interest to pediatricians may be divided into two groups: (1) those due to congenital defects of development and (2) those secondary to disturbance of function of the endocrine glands. Hypo-

54. Slotkin, G. E.: A New and Rapid Method for the Control of Urinary Tuberculosis: Preliminary Report, J. Urol. **58**:464-478 (Dec.) 1947.

55. Goldstein, A. E., and Hollander, A.: Experiences with Oxycel Gauze in Genito-Urinary Surgery, J. Urol. **59**:195-201 (Feb.) 1948.

56. Spence, H. M., and Baird, S. S.: Genital Abnormalities in Childhood as Seen by the Urologist, Texas State J. Med. **43**:364-370 (Oct.) 1947.

spadias and epispadias, examples of the former, are amenable to surgical correction. Many so-called hermaphrodites in reality suffer from third degree hypospadias. Endocrine dysfunction (usually adrenal cortex hyperplasia or tumor) may result in pseudohermaphroditism in girls or premature virilism in boys. Persistent gynecomastia in boys is best corrected surgically.

There is a wide variation in size of the normal male external genitalia. A case of true hypoplasia of unknown cause is presented.

REITER'S SYNDROME

Khoury [57] adds 2 cases of Reiter's disease to the 68 previously reported. He states that relatively mild cases go undiagnosed. One patient who had not responded to small doses of arsenicals improved rapidly when given large doses of "mapharsen."

Creecy and Beazlie [58] review the literature on Reiter's syndrome and present 2 cases which are unusual in that a striking flare-up of symptoms occurred after removal of foci of infection. The role that focal infection plays in production of Reiter's syndrome deserves further study. In both cases there was a notable flare-up of the triad of symptoms, after removal of an abscessed tooth in 1 patient and after removal of septic tonsils in the other. Both patients apparently recovered completely.

(To Be Concluded)

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57. Khoury, E. N.: Reiter's Syndrome: A Report of Two Cases with Response in One to Large Doses of Mapharsen, J. Urol. **58**:268-271 (Oct.) 1947.

58. Creecy, A. A., and Beazlie, F. S., Jr.: Reiter's Syndrome and Focal Infection, J. Urol. **59**:234-242 (Feb.) 1948.

PROGRESS IN ORTHOPEDIC SURGERY FOR 1946

A Review Prepared by an Editorial Board of the American Academy of Orthopaedic Surgeons

I. CHRONIC ARTHRITIS

Prepared by

JOHN G. KUHNS, M.D., BOSTON

IN A REVIEW of the literature on arthritis, one finds less enthusiastic reference to chrysotherapy. There is more discussion of physical therapy and its application in the treatment of patients. Surgical procedures are more clearly defined, and chronic arthritis is becoming recognized as a social problem.

SPECIAL TYPES OF ARTHRITIS

The problem of tuberculous rheumatism is brought up again. Sheldon [1] reports that he observed 6 cases in eight years. Primary and secondary forms are seen. In the primary form arthritis precedes the appearance of the tuberculosis. In the secondary form tuberculosis is interrupted by arthritic manifestations. There may be arthralgia, acute rheumatism or. chronic arthritis which resembles rheumatoid arthritis. Acute rheumatism resembling rheumatic fever was observed in 4 children. Eight patients with tuberculosis and manifestations in the joints were followed by Seligson.[2] The manifestations were not thought to indicate tuberculous infections of the joints, and tubercle bacilli were not found. He felt that the arthritic symptoms merited prolonged study. Poncet had taught that bacillary toxins caused the manifestations of tuberculous rheumatism. The author stated that some tuberculous rheumatism responded to tuberculin therapy. Desmeules and his associates [3] review the literature on tuberculous arthritis. The tubercle bacillus cannot be cultured from these joints because hydrarthrosis is absent. Three cases are reported. A man of 23 years with fibrocaseous pulmonary tuberculosis had pain in the left hip. There was no roentgenologic evidence of disease in the hip and no response to the administration of salicylates. The patient had slight fever, but there

1. Sheldon, W.: Tuberculous Rheumatism, Lancet **1**:119-121, 1946.

2. Seligson, F.: Tuberculous Poncet's Disease: Clinical Observation on Inflammatory and Degenerative Joint Reactions, Am. Rev. Tuberc. **52**:463-473, 1946.

3. Desmeules, R.; Rousseau, L., and Richard, P.: Rheumatism and Tuberculosis with Report of Cases, Laval méd. **11**:35-46, 1946.

was no deformity at the hip. A similar course was seen in a 16 year old boy. No definite proof of tuberculous infection was found in any of the cases.

[Ed. Note (J. G. K.).—I have seen a great many patients suffering from chronic arthritis, and a fair number of these had also a tuberculous infection. We have no criteria for making a diagnosis of tuberculous rheumatism. The arthritis in persons with tuberculosis behaved like the arthritis in other persons.]

The variations in rheumatoid arthritis in childhood are discussed by Coss.[4] It occurs more often in females than in males, the ratio being 5 to 1. In most cases it occurs in children 2 to 3 years of age. The articular changes are the same as those in adults. Dwarfism is common. The cause of the arthritis is unknown. There may be an insidious onset, with slight fever, changes at the epiphyses, a systolic murmur, lymphadenopathy and articular effusions. Then there may be acute migratory polyarthritis often following an infection of the upper respiratory tract. The differentiation of this from rheumatic fever may be difficult. Finally there may be late, chronic changes. Two of the author's 56 patients died. The commonest complication was amyloidosis. Recurrence of the disease after its maximum activity is rare. Most patients are left with minor deformities. Treatment consists of general measures to improve health, the prevention of deformities, the correction of the anemia and the use of salicylates. Gold therapy has not given encouraging results.

In a further study, Coss and Boots[5] discuss the skeletal changes in juvenile arthritis. There is a birdlike facies with an undershot jaw in 25 per cent of the patients. Fusion of the cervical part of the spine is seen in 7 per cent. Shortness of the fingers occurs in 11 per cent.

An autopsy report on a patient with Still's disease who died one year after the onset of the arthritis from bronchopneumonia is given by Langley.[6] The pathologic changes were indistinguishable from those of rheumatoid arthritis. Castellanos and Galan[7] report a case of sarcoidosis which resembled Still's disease. A 6 year old Cuban boy began to have involvement of his joints at the age of 3, with fever and splenomegaly. Roentgenograms showed swelling of the soft tissues.

4. Coss, J. A., Jr.: Juvenile Rheumatoid Arthritis: Still's Disease, M. Clin. North America **30**:568-575, 1946.

5. Coss, J. A., Jr., and Boots, R. H.: Juvenile Arthritis: Study of Fifty-Six Cases with a Note on the Skeletal Changes, J. Pediat. **29**:143-156, 1946.

6. Langley, F. A.: The Nature of Still's Disease: Report of a Case, Arch. Dis. Childhood **20**:155-159, 1945.

7. Castellanos, A., and Galan, E.: Sarcoidosis (Besnier-Boeck-Schaumann Disease): Case in Child Simulating Still's Disease, Am. J. Dis. Child **71**:513-529 (May) 1946.

Sarcoid granulomas were found in the subcutaneous tissues. The synovial membrane showed a chronic nonspecific inflammatory process.

Menopausal arthritis is discussed by Greenblatt and Kupperman.[8] At the menopause there may be arthralgia, rheumatoid arthritis, osteoarthritis or villous arthritis. Some form of arthritis was found in 27 per cent of women at the menopause. It occurs between the ages of 37 and 54. It is five times more common in women than in men. An artificial menopause is frequently followed by arthritic complaints. Most of the patients responded to estrogenic therapy. Pregnancy is known to have a favorable effect on rheumatoid arthritis. The arthritic process seen at the menopause subsides after a few years. Exacerbations occur during the menstrual cycle. The hands and the weight-bearing joints are affected chiefly. The diagnosis is made from the history and from the response to therapy. Two thousand to 10,000 rat units of estrogenic substance is given every seven to ten days usually for several months. Then the dosage is gradually decreased. There may be associated thyroid disturbances which require treatment.

McCracken and his co-workers[9] maintain that gout is still a forgotten disease. There is usually a long period before the disease is recognized. Forty-eight per cent of the cases are not recognized. The correct diagnosis is made during the initial attack in only 21 per cent. Acute inflammation in the first metatarsophalangeal joint should be treated as gout until it is proved to be something else. Colchicine is the most effective drug.

Two cases of Reiter's disease are reported by Twiss and Douglas.[10] In both of the patients there was a generalized lymphadenopathy. A biopsy of an inguinal lymph node showed nonspecific hyperplasia. There was a persistent eosinophilia. Blood cultures and cultures of the lymph node showed diphtheroids only. In 1 patient there was permanent ankylosis of the finger joints. There is no known therapy for this disease.

ETIOLOGY

The cause of chronic arthritis still remains uncertain. However, a number of interesting papers shed more light on this perplexing problem. Critical appraisal of the problem of focal infection is made by Freyberg.[11] He states that one must first find out whether the patient

8. Greenblatt, R. E., and Kupperman, H. S.: Menopausal Arthritis, M. Clin. North America **30**:576-583, 1946.

9. McCracken, J. P.; Owen, P. S., and Pratt, J. H.: Gout: Still a Forgotten Disease, J. A. M. A. **131**:367-372 (June 1) 1946.

10. Twiss, J. R., and Douglas, A. H. R.: Reiter's Disease: Two Cases, Ann. Int. Med. **24**:1043-1051, 1946.

11. Freyberg, R. H.: Focal Infection: A Critical Appraisal, J. Am. Dent. A. **33**:1101-1108, 1946.

has arthritis and then what kind of arthritis is present. If the arthritis is infectious, a localized infection may be a trigger mechanism which starts it. The removal of foci of infection is probably of no value in rheumatoid arthritis of long duration. Foci of infection should be attacked only as part of a broad program of treatment. There is no direct relationship between foci of infection and osteoarthritis.

Serologic studies were carried out in experimentally produced polyarthritis by Hedlund and Löfström.[12] Hemolytic streptococci isolated from a patient with scarlet fever were injected intracutaneously into 18 rabbits in three doses at four day intervals. In 5 rabbits three intravenous injections of hemolytic streptococci were given. Five rabbits were given injections intravenously for a long period every five days. Six rabbits were given injections first intracutaneously and after eight weeks intravenously. Local inflammation and abscess appeared after intracutaneous injections. In 14 of the animals acute phase proteins appeared and remained for several days. The antistreptolysin titer was increased in these rabbits, but agglutinins were not demonstrated. Of 10 rabbits given intravenous injections, the antistreptolysin titer rose. No agglutinins appeared in the first two months. Arthritis developed in 3 of these animals. Cultures of material from the joints were sterile.

Wallerstein and his co-workers[13] postulate a possible relationship of pleuropneumonia-like organisms to Reiter's disease. Agglutinations against these organisms were carried out with the serums of 102 persons. In four there was significant agglutination. In 2 of these patients Reiter's disease was present. A number of clinical studies have been carried out to determine the cause of osteoarthritis. Stecker[14] studied the relation of Heberden's nodes to other degenerative diseases of the joints. Of 94 women with Heberden's nodes, 12.6 per cent were found to have degenerative disease of the joints. Of 109 women in a control series, 3 had the same disease. He believed that while both conditions might exist independently, persons with Heberden's nodes seemed to have an increased susceptibility to degenerative disease of the joints. Oldberg[15] believes that Heberden's nodes form part of a general disturbance of growth in the skeleton. They are seen particularly in women after the menopause. He considers them to be subacromegalic due to

12. Hedlund, P., and Löfström, G.: Serologic Studies in Experimentally Produced Polyarthritis, Acta. med. Scandinav. **124**:535-544, 1946.

13. Wallerstein, R.; Valee, B. L., and Turner, L.: Possible Relationship of Pleuropneumonia-Like Organisms to Reiter's Disease, J. Infect. Dis. **79**:134-140, 1946.

14. Stecher, R. M.: Heberden's Nodes: Relation to Other Degenerative Joint Diseases, Arch. Phys. Med. **27**:409-413, 1946.

15. Oldberg, S.: Etiology of Heberden's Nodes, Acta med. Scandinav. 1946, supp. 170, pp. 381-383.

changes in pituitary function. Increased thickness in the parietal bone can be demonstrated in this condition. In another paper Stecher [16] studied the association of hypertension and obesity with degenerative diseases of the joints of the fingers in 112 women with Heberden's nodes. Ninety-two women without Heberden's nodes served as controls. The average blood pressure was the same in the two groups. No significant association between Heberden's nodes and hypertension could be found. A strong positive association between obesity and degenerative disease of the joints was reported by other writers. The author found no difference in the incidence of obesity between the persons with Heberden's nodes and the control series. Stecher and Karnosh [17] studied the effect of nerve injury on the development of degenerative disease of the joints. Heberden's nodes were found to develop extremely slowly in the presence of damage to the nerves. Three patients with injury of the nerves on one side were found to have Heberden's nodes only on the hand which was not involved. Nine more cases from the medical literature are mentioned.

Harrison [18] reviews the experiments in which desoxycortone (adrenal cortex extract) was injected into laboratory animals. In these experiments only Seyle and his co-workers produced arthritis. In 10 female rats the author performed a unilateral nephrectomy. Five of these rats were given 3 mg. of desoxycortone twice daily. The remaining 5 rats were subjected to thirty minute exposure to blasts of cold air. Later these rats were placed temporarily in a refrigerator. The author was unable to produce experimental arthritis with desoxycortone.

The question of heredity and arthritis is brought up by Stecher and Hauser.[19] They report rheumatoid spondylitis in 2 brothers and mention other cases in the literature. They wonder whether this is of etiologic significance.

[Ed. Note (J. G. K.).—In a group of 200 patients with rheumatoid spondylitis the disease was found in brothers three times and in a brother and sister once. It has always been thought that this reflected a like faulty environment, with faulty health habits, rather than a special susceptibility of tissues in families. But the study of cases has been too scanty to permit of any conclusion.]

16. Stecher, R. M.: The Association of Hypertension and Obesity to Degenerative Joint Diseases of the Fingers, J. Lab. & Clin. Med. **31**:687-693, 1946.

17. Stecher, R. M., and Karnosh, L. J.: Heberden's Nodes: The Effect of Nerve Injury upon the Formation of Degenerative Joint Disease of the Fingers, Am. J. M. Sc. **213**:181, 1947.

18. Harrison, R. G.: Relation of Adrenal Cortex (Desoxycorticosterone Acetate) to Arthritis, Lancet **1**:815-818, 1946.

19. Stecher, R. M., and Hauser, H.: The Occurrence of Ankylosing Spondylitis: Report of Occurrence in Two Brothers, Am. J. Roentgenol. **56**:601-606, 1946.

Criep [20] discussed the relation of allergy to arthritis. Its commonest manifestation is in serum sickness. Four cases are reviewed in which there was sensitiveness to various foods. The avoidance of these foods led to the complete subsidence of the articular symptoms. He groups the allergic articular symptoms as chronic infectious arthritis, transitory arthritis from a serum or drug, intermittent hydroarthrosis, Henoch's purpura and transient paroxysmal episodes.

Jonsson [21] speaks of arthralgia due to nervous causes. Usually there are no observable anatomic changes. Arthralgias can be classified as due to infection, drugs, mixed causes, endocrine factors and functional (nervous) causes. Nervous arthralgia may be transient or stable. Twenty-four women with nervous arthralgia were studied. Roentgenograms were normal. Psychic factors play the greatest role, particularly suggestion. Occupation plays no part. The prognosis is good. Treatment consists in reassurance and the use of analgesics.

INVESTIGATION

Flynn and Irish [22] found that there was a slower fall of the blood sugar content after intravenous injections of dextrose in arthritic patients. This cannot be explained on the basis of gastrointestinal dysfunction. There was approximately the same amount lost in the urine of the arthritic and of the control groups. They explained the difference on the basis of an altered threshold of hepatic hemostatic control of blood sugar. Steiner and his co-workers [23] found inflammatory, granulomatous nodular polymyositis in cases of old quiescent rheumatoid arthritis. A large amount of muscle was required for biopsy

Thomsen and his associates [24] produced arthritis in laboratory animals by injecting 0.1 cc. of 5 to 10 per cent solution of silver nitrate into the tibiotarsal joint. The limb was then incased in casts or plaster bandages. The muscles were weighed in four to seventeen days. Arthritis alone was able to cause atrophy of the soleus and tibialis anterior muscles. Immobilization in hyperextension resulted in increased weight in the tibialis anterior. With immobilization, the soleus muscle showed a greater loss in weight than when arthritis alone was present.

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20. Criep, L. H.: Allergy of Joints, J. Bone & Joint Surg. **28**:276-279, 1946.

21. Jonsson, E.: Arthralgia Due to Nervous Causes, Acta med. Scandinav. **123**:529-539, 1946.

22. Flynn, J. E., and Irish, O. J.: Blood Sugar Level in Arthritis Following Intravenous Glucose, Science **104**:344-346, 1946.

23. Steiner, G.; Freund, H. A.; Leitktentriet, B., and Maun, M. E.: Lesions of Skeletal Muscles in Rheumatoid Arthritis, Am. J. Path. **22**:103-145, 1946.

24. Thomsen, P.; Luco, J. V., and Frugone, J. E.: Changes in Weight of Muscles of Arthritic and Immobilized Arthritic Joints, Proc. Soc. Exper. Biol. & Med. **61**:34-41, 1946.

[Ed. Note (L. D. B.).—These observations are in keeping with what is seen clinically when arthritic joints are immobilized.]

Martin and others [25] tried to determine whether the peripheral circulation is impaired in arthritis. They studied 11 healthy adults and 24 patients suffering from rheumatoid arthritis. The tests were carried out in three rooms, the temperatures of which were maintained at 78, 66.2 and 90 F. and humidity at 40 per cent. The subjects all had fasted fifteen hours before the tests. They were clothed in pajamas. Temperatures on the plantar surfaces of the toes and the volar surfaces of the fingers were determined at ten minute intervals with a thermocouple. No constant defect in the peripheral circulatory adaptability was found in patients with rheumatoid arthritis. The patients suffering from arthritis could not tolerate cold well. Sometimes there was a slow decrease of cutaneous temperature in the cold room. Most change was found near inflamed joints. In arthritis vasodilatation might occur at a slower and more irregular rate.

Gibson [26] discusses the meaning of the sedimentation rate in rheumatoid arthritis. The abnormal reaction to this test, first noted by Fabraeus in 1921, results from plasma abnormalities. The wide bore tube is more sensitive. There are many errors with the use of the Westergren tube. The author uses a 5 cc. conical centrifuge tube graduated in one hundred parts by volume. Five cubic centimeters of blood is placed in a vial with 2 mg. of potassium oxalate. There is little alteration in the reaction to the test resulting from cell volume.

[Ed. Note (L. D. B.).—The value of the sedimentation rate is questionable and variable. Those who use the sedimentation should follow Gibson's suggestions.]

From his roentgenologic studies Borak [27] comes to a different conclusion in regard to ankylosis of the sacroiliac joints than the one usually drawn. In rheumatoid spondylitis he finds first increased density about the sacroiliac joints; later there is decalcification. The first fusion takes place in the lumbar region of the spine. The changes in the sacroiliac joints are not the result of the disease but are a reaction to the mechanical stresses. Degenerative changes take place in the sacroiliac joints which later result in ankylosis.

[Ed. Note (L. D. B.).—When the sacroiliac joints are involved in atrophic arthritis, there is subchondral decalcification. If increased

25. Martin, G. M.; Roth, G. M.; Elkins, E. C., and Krusen, F. H.: Cutaneous Temperature in Extremities in Patients with Arthritis, Arch. Phys. Med. **27:** 663-682, 1946.

26. Gibson, H. J.: Sedimentation Rate in Rheumatoid Arthritis, Practitioner **157:**28-35, 1946.

27. Borak, J.: Significance of Sacro-Iliac Findings in Marie-Strümpell's Spondylitis, Radiology **47:**128-141, 1946.

subchondral density is present, the process is a part of a Marie-Strümpell arthritis. It is important that the two types of arthritis be differentiated as the treatment and the prognosis are different.]

THERAPY

Steinbrocker [28] states that therapeutic results in atrophic arthritis must be evaluated objectively. The disease often fluctuates, with spontaneous remissions. Any evaluation of therapy must take into account this characteristic of the disease. Spontaneous recoveries do occur. The degree of involvement must also be taken into consideration. There should be a control series.

Steinbrocker and Blazer [29] attempt to remove the subjective influence of the patient and the prejudice of the physician. An appraisal is made once a month with a score card of swelling, motion and tenderness in the joints, the sedimentation rate, the hemoglobin content, gain in weight, pain, well-being and the functional status.

[Ed. Note (L. D. B.).—The psychic value of such appraisals should not be underestimated.]

Powell and his co-workers [30] produced arthritis in white rats with pleuropneumonia-like organisms. Four of the rats were treated with 1,000 units of streptomycin per hundred grams in nine doses and no arthritis developed. Of the untreated rats, pleuropneumonia developed in 5 and 2 died promptly. Arthritis developed in 3 surviving rats. The experiment was then repeated on 20 rats, and the same results were obtained.

[Ed. Note (L. D. B.).—This study proved that streptomycin is an efficient antibiotic for the organism used. Further studies of its value in arthritis will be of interest.]

Rosenberg gave diamidines to 6 soldiers with acute and progressive reumatoid arthritis.[31] Four were treated with "stilbamidine" and 2 with "propamidine." Each patient was given a preliminary injection of 25 mg. (buffered) in 5 cc. of distilled water. Then 50 mg. was given three times a week until 1 Gm. had been given. The patients did not appear to be benefited in any way. There was no change in the blood or in the sedimentation rate. No toxic effects were seen. Diamidines are used in various protozoan diseases.

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28. Steinbrocker, O.: Therapeutic Results in Rheumatoid Arthritis, J. A. M. A. **131**:189-193 (May 18) 1946.

29. Steinbrocker, O., and Blazer, A.: A Therapeutic Score Card for Rheumatoid Arthritis, New England J. Med. **235**:501-506, 1946.

30. Powell, H. M.; Jamieson, W. A., and Rice, R. M.: Effectiveness of Streptomycin in Arthritis of Rats, Proc. Soc. Exper. Biol. & Med. **62**:8-9, 1946.

31. Rosenberg, E. F.: Diamidines in Chemotherapy, Ann. Int. Med. **25**:832-844, 1946.

Ten patients with rheumatoid arthritis were inoculated with 0.5 or 1.0 cc. of serum from patients with acute infectious hepatitis. Jaundice developed in 2 patients, with a temporary remission of the arthritis. The arthritis relapsed in each of these patients in six months. The authors [32] concluded that it was a dangerous and ineffective form of treatment.

[Ed. Note (L. D. B.).—When sterol metabolism is better understood, one of the causes of arthritis may be discovered.]

A number of papers were written on gold therapy. For the most part these are more critical and less enthusiastic than previous reports.

Kersley [33] believes that chrysotherapy is of definite value in active rheumatoid arthritis. Severe reactions are rare if a crystalloid compound of gold is given in doses of not more than 50 mg. once weekly and not more than 1 Gm. in all. The treatment must be discontinued in 12 per cent of the cases on account of dermatitis. Short, Beckman and Bauer [34] state that water-soluble compounds are preferable for therapeutic use. These should be given in small weekly doses. They suggest trying BAL (2,3 dimercaptopropanol) for toxic reactions. Gold salts are effective only in rheumatoid arthritis and cannot be considered as specific agents. The effects procured approximate those seen in patients given general conservative therapy. The toxic effects militate against the general use of gold therapy. Cecil [35] states that a cutaneous rash develops in 25 per cent of patients receiving gold. Gold is excreted slowly. One should start with a dosage of 10 mg., which is later increased to 50 or 100 mg. Treatment should be continuous and not in courses, and should be given until the patient is free of symptoms. If a relapse in arthritis develops an initial dosage of 5 to 10 mg. should be given. If dermatitis develops administration should be stopped until the rash has gone and then small doses given at first. If there is no improvement in five months, the use of gold should be discontinued. Cecil feels that this therapy is safe if the patient is watched carefully. Oren [35a] studied 150 patients with rheumatoid arthritis who were treated with a 5 per cent solution of a sulfhydryl gold naphthyltrisulfocarbonium derivative ("aurocein"). Ninety per cent showed a favorable thera-

32. Rennie, J. B., and Fraser, T. N.: Transmission of Acute Infectious Hepatitis: Therapeutic Effect upon Arthritis, Glasgow M. J. **27**:157-166, 1946.

33. Kersley, G. D.: Modern View of Gold Therapy, M. Press **216**:296-297, 1946.

34. Short, C. L.; Beckman, W. W., and Bauer, W.: Medical Progress: Gold Therapy, New England J. Med. **235**:362-368, 1946.

35. Cecil, R. L.: Problem of Dosage in the Administration of Gold Salts for Rheumatoid Arthritis, M. Clin. North America **30**:545-552, 1946.

35a. Oren, H.: Aurocein in Rheumatoid Arthritis: One Hundred and Fifty Additional Cases. M. Record **159**:420, 1946.

peutic result. Two cubic centimeters of this compound was given per week. Cutaneous reactions were found in 2 per cent.

The case histories of 4 patients with rheumatoid arthritis in whom intercurrent jaundice developed while they were being treated with gold salts are reported by Hartung.[36] All felt better when jaundice was present, and all had relapses in their arthritis when the jaundice disappeared. It was not definitely established that the jaundice was caused by the gold therapy. Forestier[37] treated 40 patients with cupric allylthiourea, which contains 19 per cent copper. Biweekly injections of 0.1 grain (6 mg.) were given until 1.5 grains (0.1 Gm.) had been given. Twenty per cent of the patients were much improved, and 30 per cent recovered completely. He felt that this was a useful treatment for patients with rheumatoid arthritis who were resistant to gold. It was of no value in spondylitis.

[ED. NOTE.—Crysotherapy is of some value in the treatment of active rheumatoid arthritis. Its action is unknown. Readily soluble compounds are most effective. It seems to be safest when given in small doses for a prolonged period, i. e., two to three months. Toxic reactions are not predictable or wholly preventable. It will take some time to determine whether BAL is effective in treating these toxic reactions.]

The use of vitamins is discussed by Traeger.[38] Vitamin A has no proved place in the therapy of arthritis. No effects are seen with large doses. Vitamin B complex and its various components produce no definite effect. A temporary erythema occurs when nicotinic acid is given. Vitamin C is of no value. Vitamin D therapy is of benefit, though intolerance occasionally occurs. Improvement often continues after the medication (vitamin D) is stopped. No increased calcification was observed. One hundred and two patients with arthritis who had been given 100,000 to 2,000,000 units of vitamin D ("ertron") weekly were followed by Horwitz and Joseph[39] for one and a half years. Sixty-two per cent were improved. There was no definite change in blood pressure, and no metastatic calcification was seen in the patients followed for as long as ten years. They studied the adenylic acid content of the blood and found that it was not affected significantly. They stated that "ertron" was a relatively safe therapeutic measure and that the potential dangers were greatly overstressed.

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36. Hartung, E. F.: Toxic Hepatitis During Gold Salts Therapy, M. Clin. North America **30**:553-561, 1946.

37. Forestier, J.: Indications et technique des composés organo-métalliques de cuivre dans le rhumatisme chronique, Bull. Acad. de méd., Paris **130**:298-299, 1946.

38. Traeger, C. H.: Use of Vitamins in the Treatment of Chronic Arthritis, M. Clin. North America **30**:616-622, 1946.

39. Horwitz, A., and Joseph, N. R.: Prolonged Observation on a Group of Arthritic Patients Treated with Ertron, Indust. Med. **15**:100-105, 1946.

On the other hand, both Paul [40] and Kingsbury [41] report toxic manifestations from the use of large doses of vitamin D. Paul observed 5 patients with vitamin D poisoning, and he stated that toxic effects occurred more readily when milk was taken. The usual signs were headache, nausea, vomiting, diarrhea, polyuria and polydypsia. The ultimate course of the arthritis was not changed. The urine should be examined and the serum calcium level determined frequently when large doses of vitamin D are given. Kingsbury's patient improved after the use of vitamin D was discontinued and the calcium intake reduced.

Warter and others [42] studied the effect of hesperidin (vitamin P) and ascorbic acid on the capillary fragility in 20 patients with rheumatoid arthritis. They found that hesperidin in doses of 100 mg. benefited abnormally fragile capillaries. Ascorbic acid alone was of no benefit, and the combination of the two was of great benefit.

Injection of various drugs has been used for their local effect. Jodovich and Nobel [43] found that pain in osteoarthritis was frequently relieved by injection of 5 cc. of 1 per cent procaine hydrochloride when the injection was given directly into the painful and spastic tendons (gluteus and pyriformis).

Eastwood [44] found that subcutaneous injections of histamine, 0.1 to 0.5 mg. two or three times a week, produced a local feeling of warmth. Later there was some relief in the adjacent joint. Seventy patients were treated, and 74 per cent improved.

Balboni and his associates [45] gave injections of prostigmine up to the limit of tolerance in 23 patients with rheumatoid arthritis. Only 2 patients showed any appreciable decrease in muscular spasm. Distressing symptoms were caused in 14 patients. They did not recommend the use of prostigmine to relieve muscular spasm in rheumatoid arthritis.

Roentgen therapy has been used extensively in the treatment of arthritis. Freyberg [46] advocates it especially for rheumatoid spondylitis.

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40. Paul, W. D.: Toxic Manifestations of Large Doses of Vitamin D, J. Iowa M. Soc. **36**:141-147, 1946.

41. Kingsbury, I. W.: Vitamin D Poisoning, Connecticut M. J. **10**:25, 1946.

42. Warter, P. J.; Drezner, H. L., and Horoschak, S.: Effect of Hesperidin and Ascorbic Acid on Capillary Fragility in Rheumatoid Arthritis, J. M. Soc. New Jersey **43**:228, 1946.

43. Judovich, B., and Nobel, G.: Relief of Pain in Osteoarthritis of the Hip Joint, Am. J. Surg. **72**:72-73, 1946.

44. Eastwood, C. G.: Histamine Injection Therapy in Chronic Rheumatism, Gen. Practitioner **17**:105-107, 1946.

45. Balboni, V. G.; Hollander, J. L., and Kydd, D. M.: Effect of Prostigmine (Neostigmine) on Muscle Spasm in Arthritis, Am. J. M. Sc. **212**:153-158, 1946.

46. Freyberg, R. H.: Roentgen Therapy for Rheumatic Diseases, M. Clin. North America **30**:603-615, 1946.

He applies a total of 600 r to each of five areas in the back. Usually there is a fairly prompt subsidence of pain and stiffness. If nausea and anorexia occur, he gives 15 mg. of thiamine chloride three times a day. The action of the roentgen rays is unknown, but irradiation of the muscles of the back seems to be important. The results of roentgen therapy in peripheral rheumatoid arthritis are unpredictable. In osteoarthritis some temporary relief may occur. It is sometimes helpful in nonarticular rheumatism. Gelber [47] states that roentgen therapy is both efficient and economical in arthritis. The results are lasting. There are no adverse effects. He advises the use of radioactive ointment after roentgen therapy.

Kuhns and Morrison [48] report a study of 370 patients with chronic arthritis who were given roentgen therapy. Two hundred and fifty-two had rheumatoid arthritis, and 118 had osteoarthritis. The greatest improvement (84.6 per cent) was found in rheumatoid spondylitis. Improvement was measured by objective findings. The effect of the treatment was local and not systemic. The local condition of the joint was the important factor. Patients with severe deformity or mechanical derangement of the joint showed little improvement. Usually 1,200 r in twelve doses was given. Repeated courses did not insure the permanence of the improvement. Unpleasant effects were rarely observed with this dosage, and no damage to the skin or the articular tissues was found.

PHYSICAL THERAPY

Physical therapy is receiving greater recognition, particularly in the rehabilitation of patients with arthritis. Capener [49] in his Arrés and Gale lecture defines physiologic rest as a controlled process which provides immobilization while safeguarding functional restoration. The position of the limb and the duration of rest vary according to the condition being treated. Strict immobilization is required for arthritis when the joint is acutely inflamed. Later one must strike a nice compromise between muscular competence and later requirements for joint posture. Various traction devices are illustrated in the article. Schmidt [50] discusses various types of physical therapy for chronic arthritis. He recommends prolonged rest in the acute stage and heat and ionization for relief of pain and absorption of exudate. Later,

47. Gelber, L. J.: Roentgentherapy of Arthritides and Ligamentous, Tendinous and Bursal Inflammation, M. Rec. **159**:415-420, 1946.

48. Kuhns, J. G., and Morrison, S. L.: Twelve Years' Experience in Roentgentherapy for Chronic Arthritis, New England J. Med. **235**:399-405, 1946.

49. Capener, N.: Physiologic Rest, Brit. M. J. **2**:761-766, 1946.

50. Schmidt, L.: Choice of Physiotherapy at Various Stages in Chronic Rheumatism, Brit. J. Phys. Med. **9**:104-110, 1946.

muscular rehabilitation is required. In cases of osteoarthritis heat and massage are of the most value. The most rapid relief was obtained in fibrositis with iodine ionization.

Kovacs [51] states that physical therapy should be prescribed carefully in cases of arthritis. He discusses thermal and mechanical measures, hydromassage and counterirritation measures. Periarticular tissues respond rapidly to such measures. Spa treatment fills a need. Much can be done at home with simple measures. Electrical gadgets have no place in the treatment of arthritis.

Massage is advocated by Hopkins [52] for the treatment of rheumatoid arthrtis. Myositis accompanies arthritis in most cases. Skillful massage will help to keep pain in abeyance. Often it must be given vigorously to the diseased muscles but not if they are acutely inflamed. Induration should be relieved. The author considers massage to be the most useful measure in physical therapy.

ORTHOPEDIC MEASURES

A small number of papers discuss orthopedic measures. In a general paper Balensweig [53] states that deformity is prevented by rest, physical therapy, support and manipulation. Deformity is corrected by manipulation and by surgical intervention. Function is improved by physical therapy and by osteotomy or arthroplasty. Pain is relieved by splinting, physical therapy, roentgen therapy and surgical measures.

Patrick [54] uses a fibular graft in a tunnel above a Smith-Petersen nail for arthrodesis of the hip in osteoarthritis. Two or three days later a short spica is applied and knee exercises are given. The patient walks on crutches in five days. This procedure should not be used in cases of severe bilateral arthritis or if the lumbar region of the spine is much involved. The graft may break in obese patients. Twenty-five patients were operated on. Solid fusion developed in 34. Karlen [55] feels that intra-articular arthrodesis is often too severe a measure for osteoarthritis of the hip in the aged. He advocated subtrochanteric osteotomy followed by pegging of the fragments. A rotation osteotomy or a wedge osteotomy is first carried out to correct deformity. A peg is driven through the proximal fragment. The fragments are then mitered together. Four cases are reported.

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51. Kovacs, R.: Physical Therapy in Chronic Arthritis, M. Clin. North America **30**:623-634, 1946.

52. Hopkins, F.: The Value of Massage in Rheumatoid Arthritis, Virginia M. Monthly **73**:62, 1946.

53. Balensweig, I.: What Can Orthopedics Offer the Arthritic? M. Clin. North America **30**:635-644, 1946.

54. Patrick, J.: Pin and Graft Arthrodesis for Osteoarthritis of the Hip, Lancet **2**:9-11, 1946.

55. Karlen, A.: A New Method of Arthrodesis in Arthritis Deformans Coxae, Acta chir. Scandinav. **94**:168-170, 1946.

A muscle flap transplant was used by Venable and Stuck [56] to improve the local circulation in nonarticular arthritis of the hip. They believe that osteoarthritis is akin to aseptic necrosis. A groove 1 by 4 cm. is made in the femoral neck. The origin of the vastus lateralis is transplanted into this groove and sutured there. The authors are of the opinion that the transplant provides a better blood supply and that pain is relieved. Twenty-seven patients were operated on, and 26 were relieved of pain. Early motion and early weight bearing are advised.

LaChapelle [57] reports a surgical correction of the kyphosis in rheumatoid spondylitis in 1 patient. The best place for correction is at the third lumbar vertebra. The operation is carried out in two stages. First the laminal and posterior articulations are removed, and then the disk is removed and a bone graft applied with the spine in a corrected position.

Hench and Boland [58] discuss the management of chronic arthritis among soldiers. Most patients could be treated in a general hospital, but centers for the treatment of rheumatic disease are necessary in some instances. Five such centers have been established in order that accurate diagnosis, intensive treatment and rehabilitation can be carried out. There was a particularly high incidence of rheumatoid spondylitis and psychogenic rheumatism. Fifteen to 20 per cent of the soldiers at centers for the treatment of rheumatic disease had psychogenic rheumatism. With prompt, effective treatment, many unnecessary discharges and payments of pensions were prevented. Of 1,300 patients treated in one center, 45 per cent returned to some type of military duty.

Copeman [59] states that any disease becomes a social problem when the persons affected are a danger or a burden to their fellow citizens. Hospitals should be established for the treatment of rheumatic disease. It becomes a serious industrial problem when it involved the large amount of absence from work. In the British Isles two million pounds are paid as sick benefit for arthritis yearly. Much can be done to prevent the occurrence of the disease in the industrial worker by the prevention of infection, malnutrition, trauma and fatigue. Special legislation is required to cope with the public health aspects of arthritis.

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56. Venable, C. S., and Stuck, W. C.: Muscle-Flap Transplant for Relief of Painful Monarticular Arthritis, Tr. South. S. A. **57**:172-186, 1946.

57. LaChapelle, E. H.: Osteotomy of the Lumbar Spine for Correction of Kyphoses in a Case of Ankylosing Spondylarthritis, J. Bone & Joint Surg. **28**: 831-858, 1946.

58. Hench, P. S., and Boland, E. W.: Management of Chronic Arthritis and Other Rheumatic Diseases Among Soldiers of the United States Army, Ann. Rheumat. Dis. **5**:106-114, 1946.; Ann. Int. Med. **24**:808-825, 1946.

59. Copeman, W. S. C.: Rheumatism As a Social and Industrial Problem, Brit. J. Phys. Med. **9**:66-70, 1946.

II. CONDITIONS INVOLVING THE KNEE JOINT

Prepared by
RALPH K. GHORMLEY, M.D.
Assisted by
JOSEPH M. JANES, M.D.; A. R. W. PILS, M.D.; JACK PASCHALL Jr., M.D.; RUSS B. GRAHAM, M.D.; DOUGLAS T. LINDSAY, M.D.; MARTIN E. ANDERSON, M.D.; GEORGE M. HART, M.D.; J. G. BATEMAN, M.D.; BRUCE M. CAMERON, M.D., and R. SCANDALIS, M.D.
ROCHESTER, MINN.

Anatomy and Physiology.—Haxton,[60] by using tensometers, found that the leverage of action of the extensor muscles on the knee and elbow becomes greater as the joints are extended from the flexed position. The leverage is greater in the knee, and it extends over a greater range of movement of the joint. This is because of the anatomic features of the joints which determine the relationship of the axis of the joint to the extensor tendons, for example, in the knee the combination of the patella and the posterior relationship of the femoral condyles and in the elbow the posterior projection of the olecranon process. Disadvantages of the mechanism of movement are discussed.

In a short article, Brantigan and Voshell[61] described the relationship of the ligament of Humphrey to the ligament of Wrisberg. The ligament of Wrisberg is behind the posterior cruciate ligament, while the ligament of Humphrey is in front of it.

Pathologic Conditions of the Knee Joint.—Synovial Membrane: Soubigou[62] reported the results of biopsy of specimens of synovial fluid in 23 cases of hydrarthrosis. In 5 cases in which the cause was unknown the diagnosis was made certain by the results of biopsy; in 4 cases the condition was tuberculosis (culture of the aspirated fluid was sterile) and in 1 case the condition was xanthomatous synovitis for which the prognosis was good. In 3 cases biopsy confirmed the presence of foreign bodies in the joint. In 2 cases of chronic arthritis the histologic picture was typical. In 1 case in which biopsy showed only hypervascularization and lipomatous tissue the true condition was

60. Haxton, H.: A Comparison of the Action of Extension of the Knee and Elbow Joints in Man, Anat. Rec. **93**:279-286 (Nov.) 1945.

61. Brantigan, O. C., and Voshell, A. F.: Ligaments of the Knee Joint: The Relationship of the Ligament of Humphry to the Ligament of Wrisberg, J. Bone & Joint Surg. **28**:66-67 (Jan.) 1946.

62. Soubigou, X.: La biopsie synoviale dans les hydarthroses, Rev. méd. nav. **1**:55-58, 1946.

proved four months later to be sarcoma. Perivascular lymphoblastic infiltration in 1 case pointed toward the diagnosis of syphilis, which was later confirmed by serologic tests. In 11 cases of chronic synovitis biopsy did not offer any clue as to the cause.

[Ed. Note.—With present surgical technic, biopsy in cases of doubtful causation is a well justified procedure.]

Arthrosis of the Knee After Meniscectomy: Nitter [63] discussed the various causes of postoperative arthrosis of the knee and paid special attention to the altered static condition in the joint after meniscectomy. A survey of the condition of 35 patients after total meniscectomy showed that 83 per cent had obtained excellent or good results whereas in 34 per cent there were roentgenographic signs of arthrosis. The longer the operation, the more extensive are the roentgenologic changes as well as the clinical signs. There is good reason to assume that the danger of arthrosis might result in more general adoption of partial resection in order to maintain the normal static conditions.

[Ed. Note.—This article points up the fact that insistence on complete removal of the entire cartilage may produce so much surgical trauma as to cause undue trouble to develop postoperatively.]

Osteochondritis Dissecans: Hermanson [64] presented 3 cases in which bilateral osteochondritis dissecans of the knee joint was discovered during routine roentgenographic examination of the knees of 92 soldiers on duty. The incidence and causation are discussed.

Mathez [65] drew attention to the constant convexity of the bottom of the niche in osteochondritis dissecans and wrote that this is the immediate and mathematic consequence of the form of the condyles and that the bottom of the niche is a Looser zone, vibration fracture. He further said that the relative frequency of occurrence of osteochondritis dissecans in the cretin is explained perfectly well by the architectural feebleness of the epiphysis behind the lesion.

[Ed. Note.—This explanation may hold true for osteochondritis dissecans in the knee joint, but it does not seem to be a likely explanation of its occurrence in other joints.]

Bonnin [66] found osteochondritis dissecans on the lateral femoral condyle of a soldier who seven months previously had injured his right

63. Nitter, L.: Arthrosis in Knee After Meniscectomy, Acta chir. Scandinav. **93**:483-494, 1946.

64. Hermanson, R. H.: Bilateral Osteochondritis Dissecans of Knee, Radiology **47**:349-354 (Oct.) 1946.

65. Mathez, J. A.: Le problème de l'ostéochondrite disséquante; la raison de la convexité constante du fond de sa niche; explication de sa fréquence relative dans le crétinisme, Presse méd. **54**:211-212 (April 5) 1946.

66. Bonnin, J. G.: Osteochondritis Dissecans and Torn Lateral Meniscus, Brit. J. Surg. **33**:380-381 (April) 1946.

knee when he jumped from a platform. At operation, a bucket handle tear of the external meniscus was found, with the cartilage displaced into the joint in such a manner that it produced friction on the osteochondritic area whenever the joint was moved. The torn cartilage was removed, and multiple drill holes were placed in the osteochondritic plaque to permit its revascularization.

The case was presented with the suggestion that this process may be initiated by trauma that produces a subchondral fracture, with incomplete separation, and that the displaced cartilage secondarily may have caused the development of osteochondritis by continued friction of the damaged surface.

Forssman [67] reported 3 cases in which refugee infants with type C paratyphoid were found to have roentgenologically demonstrable osteitis with periosteitis in the metaphyses around the knee joint.

Internal Derangements of the Knee: Lenggenhager [68] discussed the diagnosis of lesions of the posterior horn of the meniscus. He believed the following signs to be diagnostic: (1) pain in the posterior part of the joint while the tibia is pulled forward, (2) painful crepitation or "snapping" when the tibia is pulled forward, (3) local tenderness in the posterior joint space behind the collateral ligaments, (4) pain on maximal flexion, (5) pain on flexion of the knees over the examiner's arms in the popliteal fossa, i. e., the so-called "nutcracker sign," (6) crepitation on rotation of the tibia with a slightly flexed knee, (7) crepitation or snapping on moving the knee flexion to extension while the tibia is pulled forward, (8) crepitation on abduction and adduction of the leg while the knee is held in 5 degrees' flexion and (9) a characteristic way of locking which is (*a*) short lasting, (*b*) found to occur in extreme flexion and (*c*) elicited when flexion is suddenly changed to extension. Explanations of these various signs are attempted by the author.

Terhune and Gill [69] reviewed 60 cases in which patients had undergone operation consecutively in nine months for internal derangements of the knee. Diagnosis, operative technic and results are fully discussed. Law [70] reviewed 120 arthrotomies of the knees in soldiers. The average time during which a patient was absent from duty in a forward area

67. Forssman, G.: 3 Cases of Skeletal Changes Round the Knee Joint in Paratyphoid Fever in Infants, Acta radiol. **27**:294-299, 1946.

68. Lenggenhager, K.: Zur Diagnose der Meniskus-Hinterhornläsion, Schweiz. med. Wchnschr. **76**:758-762 (Aug. 17) 1946.

69. Terhune, S. R., and Gill, G. G.: Evaluation of Surgical Treatment of Internal Derangements of Knee in Army General Hospital, J. M. A. Alabama **16**:1-6 (July) 1946.

70. Law, W. A.: The Problem of Meniscectomy: Problem in the Soldier, J. Bone & Joint Surg. **28**:496-500 (July) 1946.

was eighty days. Twenty-five of the patients were not returned to full duty. Of 54 of those who returned to front line duty, 6 had recurrence of pain, effusion or instability sufficient to necessitate additional hospitalization.

Dittrich [71] noted that cysts of the menisci are not uncommon; they are found most frequently in the lateral meniscus. The diagnosis usually is simple because such cysts almost always present a visible or palpable swelling at the outer margin of the meniscus. Concealed cysts, i. e., those arising from the free border of the cartilage and projecting into the joint, are extremely rare. The author reported the occurrence of a cyst near the anterior detached pole of a lateral meniscus removed four years after the original injury.

Knee Wounds and Injuries: Thompson, Cassebaum and Stewart [72] reported their experiences with 172 patients who had penetrating wounds of the knee joint. They stated that surgical treatment is urgent and that large exposures should be used, through two or more incisions, so that all devitalized bone and cartilage and foreign material are removed. They advocated thorough irrigation of the joint with isotonic solution of sodium chloride and incision and exploration of wounds on entrance and exit. They said that they closed the synovium and capsule tightly, with the use of sliding pedicles of skin and subcutaneous tissue if necessary. They reported that they leave skin closure until the fourth to the tenth day. They instil 10,000 units of penicillin and employ aspiration, repeating the process if necessary. They immobilize the extremity in a spica cast.

Writing on the same subject, Parker and Modlin [73] observed that infection can be controlled and a functioning joint obtained if (1) all actually or potentially devitalized tissue and foreign materials are removed, (2) the knee joint can be closed, (3) there is systemic and intra-articular use of penicillin and (4) active early motion is accomplished. Two hundred and forty-four penetrating and perforating wounds of the knee joint were treated. Clinical infections developed in 29, 15 of which were explored and débrided. In these 15 the menisci were removed and the joints closed. One wound persisted in draining because of osteomyelitis of the femoral condyles.

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71. Dittrich, R. J.: Concealed Cysts of the Lateral Meniscus of the Knee: Report of a Case, J. Bone & Joint Surg. **28**:646-647 (July) 1946.

72. Thompson, J. E.; Cassebaum, W. C., and Stewart, C. F.: Early Management of Penetrating Wounds of Knee Joint, U. S. Army M. Bull. **5**:439-444 (April) 1946.

73. Parker, J. M., and Modlin, J.: Symposium: Medicine and Surgery in 21st General Hospital: Compound Injuries of Knee Joint, Washington Univ. M. Alumni Quart. **9**:54-58 (Jan.) 1946.

Jones [74] reviewed the subject of surgical diagnosis of acute injuries of the knee joint. He presented types of injuries, diagnostic criteria and prognosis.

Schwartz [75] noted that in the presence of hemarthrosis atrophy of the quadriceps femoris may appear with astounding rapidity, at times within twenty-four hours. This author expressed the belief that such atrophy is due to a reflex mechanism which protects the articular synovial membrane and that the atrophy finally will dominate the functional outcome. If it is not appropriately treated, he said, it usually will result in recurrent hydrarthrosis. The importance of immediate exercise is stressed.

The Patella: Little and Hudson [76] discussed chondritis of the patella, noting that it simulates derangements of the menisci, with usually a history of trauma, transitory acute synovitis followed by chronic disability and aching over the patella after prolonged sitting with flexed knees which is relieved by changing of the position. There is clicking or grating behind the patella but no locking. Flexion is limited by pain, and pain is elicited by the exertion of pressure against the patella in its inferomedian portion or by digital pressure exerted on the under surface of the patella after it has been displaced medially with the knee extended. Results of roentgenologic examination usually are negative. The treatment used when the condition is mild and early consists in the employment of counterirritants and heat for three weeks and then, if no improvement results within that time, arthrotomy carried out via a medial parapatellar incision and shaving off of the affected articular cartilage. Patellectomy should be performed if more than a third of the total articular surface is involved.

Sutro [77] reported 58 cases of various anomalies and changes in the patella. He felt that trauma is an important factor in the production of symptoms. He described three tests, i. e., the contact test, the resistance test and a stretching test. He advocated arthrotomy, with excision of the damaged cartilage.

Horwitz and Lambert [78] reported on 19 patellectomies performed in the military service. They stated that the main fault in the performance of most patellectomies is failure to take up the correct amount

74. Jones, G. B.: Surgical Diagnosis of Acute Injuries of the Knee Joint, S. Clin. North America **26**:402-409 (April) 1946.

75. Schwartz, A.: L'atrophie du quadriceps fémoral dans les hydarthroses et les hémarthroses traumatiques de genou, Paris méd. **1**:56-60 (Feb. 7) 1946.

76. Little, N., and Hudson, C.: Chondritis of the Patella, M. J. Australia **1**:398-399 (March 23) 1946.

77. Sutro, C. J.: Fissures of the Articular Cartilage of the Patella: Occurrence in Multipartite Patella, Surgery **19**:251-266 (Feb.) 1946.

78. Horwitz, T., and Lambert, R. G.: Patellectomy in the Military Service: A Report of Nineteen Cases, Surg., Gynec. & Obst. **82**:423-426 (April) 1946.

of slack in the patellar tendon. Assuming that the average patella is 2 cm. thick and 5 cm. long, the authors calculated that lateral plication of 1.6 cm., with a longitudinal incision, is the correct amount of slack to take up. In actual practice, if all available tissue is plicated without tension, the result will be the same. These authors reported 10 cases of compound comminuteed fractures, 8 cases of chondromalacia and 1 case of ununited fracture. They said that the range of movement after patellectomy is conditioned by the range of movement that existed prior to surgical operation.

Breck and Higinbotham [79] advocated mattress suturing of the skin to the underlying tissues in closure of the wound after excision of prepatellar bursas.

Pneumoroentgenography of Knee Joints: Pneumoroentgenography was discussed by Brooke, MacKenzie and Smith.[80] This procedure was recommended only in difficult cases in which the diagnosis is not clear. The method of injection of oxygen as well as the roentgenologic technic was described, and the cardinal points of diagnostic value in the interpretation of pneumoroentgenograms of the knee were outlined. These points were (1) roughened or narrow articular surfaces, (2) uninterrupted columns of gas along the inner aspect of collateral ligaments, (3) separation of shadow of the meniscus from contiguous bone structures, (4) loose or semiloose bodies and (5) narrowed joint spaces. The use of the curved cassette holder and of multiple stereoprojections adds to the accuracy and usefulness of the procedure.

Butts and Mitchell [81] likewise reported the result of this procedure in 25 patients, with a rate of diagnostic accuracy of 75 per cent.

Leger, Olivier and Linart [82] surveyed the development of arthrography, described the technic and discussed its value as a diagnostic procedure.

Somerville [83] described in detail the sterile technic for the injection of filtered air into the knee joint for roentgenographic demonstration of lesions of the intra-articular structures. His illustrations show that

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79. Breck, L. W., and Higinbotham, N. L.: Patellar and Olecranon Bursitis with the Report of an Improved Operative Procedure, Mil. Surgeon **98**:396-399 (May) 1946.

80. Brooke, H. H. W.; MacKenzie, W. C., and Smith, J. R.: Pneumoroentgenography with Oxygen in Diagnosis of Internal Derangements of Knee Joint, Am. J. Roentgenol. **54**:462-469 (Nov.) 1945.

81. Butts, J. B., and Mitchell, J. T.: Pneumoroentgenarthrography As Diagnostic Aid in Internal Derangements of Knee, U. S. Nav. M. Bull. **46**:77-82 (Jan.) 1946.

82. Leger, L.; Olivier, C., and Linart, R.: Quelques images d'arthrographies du genou, Presse méd. **53**:694-696 (Dec. 22) 1945.

83. Somerville, E. W.: Air Arthrography As an Aid to Diagnosis of Lesions of the Menisci of the Knee Joint, J. Bone & Joint Surg. **28**:451-465 (July) 1946.

tears of the medial and lateral menisci can be demonstrated by this method. He was able to diagnose such lesions in 324 examinations with a high degree of accuracy. The presence of fluid within the joint interferes with air arthrography. The injection of air into a joint sometimes produces a transient effusion which was not found to be harmful.

Lesions of Ligaments: Discussing the Pellegrini-Stieda disease, Russell and Smith [84] described two types: (1) evolutive, which is treated by roentgen therapy though this has not proved of value and (2) the stabilized type, which should be treated by surgical removal if the symptoms warrant it. According to these authors, the three types of origin of this disease are (1) subperiosteal hemorrhage and metaplasia of the medial collateral ligament, (2) separation of a bony fragment and (3) the development of a hematoma within connective tissue, with subsequent calcification.

Richman and Barnes [85] presented 85 cases of acute instability of the ligaments of the knee to show (1) a new mechanism of injury to the knee ligaments and (2) the results of conservative treatment in such cases. In 59 of the 85 cases injuries to the tibial collateral ligament had been produced by severe abduction of the knee when the leg was caught in the suspension lines of a parachute and forcibly abducted as the parachute opened. In the remaining cases the injuries were miscellaneous and included adduction injuries and in one instance complete anterior dislocation of the tibia. The left knee was injured in 49 of the 59 cases because of the location of the single exit on the port side of the C-47 airplane; as the canopy of the parachute trailed behind, the lines crossed and entangled the jumper's left leg.

Treatment consisted of immediate (within twenty-four hours) immobilization of the extremity in plaster from the toes to the groin, with the knee in slight varus and with 30 degrees of flexion (150 degrees). After three to four weeks, a walking cylinder was applied, with 5 degrees of flexion, and this cylinder was maintained for three to five weeks. No supports were used after that time other than a Thomas heel.

Intensive exercises of the quadriceps femoris were begun while the extremities were still in the casts; these progressed later from simple extension and flexion in bed to knee bends and cross-country bicycle rides.

The results of treatment were evaluated in terms of pain, degree of instability, atrophy of the quadriceps femoris, range of motion, intra-

84. Russell, D. A., and Smith, C. D.: Pellegrini-Stieda Disease, Radiology **45**:351-355 (April) 1946.

85. Richman, R. M., and Barnes, K. O.: Acute Instability of the Ligaments of the Knee As a Result of Injuries to Parachutists, J. Bone & Joint Surg. **28**: 473-490 (July) 1946.

articular fluid, clicking, determination and attitude of the patient and agility. The degree of atrophy of the quadriceps was found to be the most reliable criterion of functional results.

Ninety-five per cent of the abduction injuries resulted in less than 5 degrees of residual instability. Calcification of the tibial collateral ligament was a frequent complication but did not prove disabling. Recovery of flexion and extension was excellent.

Several reports of cases were included. The article is interesting and well written. Excellent results have been obtained after conservative treatment of conditions which have been often considered to require surgical treatment.

Hendryson [86] presented 6 cases of bursitis in the region of the fibular collateral ligament proved by operative removal. The author presumed his paper to be the first report of such cases. The patients complained of pain at the lateral aspect of the knee, aggravated by exercise and relieved by rest. Examination showed a localized tender mass at or near the fibular collateral ligament, with pain on adduction of the tibia, extension of the knee and on internal rotation of the tibia on the femur. The treatment advised is excision if a mass is present, aspiration, injection of procaine hydrochloride, compression and rest. Hendryson pointed out that these lesions may be multilocular, with contents that are difficult to aspirate, and that they must be distinguished from cysts of the lateral meniscus.

Warren [87] reported a case in which a ganglion in the area of the head of the fibula had compressed the common peroneal nerve into a thin band.

Tibial Tubercle: Bosworth and Thompson [88] reported a method of fixation of the transplanted tibial tubercle by the use of a metal plate with three holes. Two screws are passed through the tubercle and one in the shaft of the tibia.

Judet [89] described a procedure for the relief of osteochondrosis of the tibial tuberosity. Good results have been obtained by total excision of the tuberosity and suture of the patellar tendon. Another procedure is described in which the author drilled eight to twelve holes and employed a Kirschner wire in a concentric pattern. Relief was obtained

86. Hendryson, I. E.: Bursitis in the Region of the Fibular Collateral Ligament, J. Bone & Joint Surg. **28**:446-450 (July) 1946.

87. Warren, R.: Ganglion of the Common Peroneal Nerve: Case Report, Ann. Surg. **124**:152-155 (July) 1946.

88. Bosworth, D. M., and Thompson, F. R.: Fixation of the Transplanted Tibial Tubercle, J. Bone & Joint Surg. **28**:285-287 (April) 1946.

89. Judet, J.: Traitement des apophysites et de la maladie de Lannelongue-Osgood-Schlatter par perforations multiples, Mém. Acad. de chir. **72**:332-335 (June 5-12) 1946.

in all cases. The author said that these palliative measures will suffice in the treatment of such patients.

Unusual Conditions: Sutro [90] found that 8 of 500 soldiers examined and found to have lesions of the knee exhibited a coarse tremor of the ipsilateral lower extremity, brought on by active extension of the leg. Six of these patients showed evidence of an anxiety state. Arthrotomy was performed on 2; 1 of these obtained complete recovery and the other was separated from the service because of aggravation of the tremor. In the nonoperative group of 6 patients only 1 obtained recovery after vocational readjustment, the others being separated from the service because of persistence of the tremor and symptoms.

Technical Procedures.—Magnuson [91] discussed the symptoms, examination, surgical indications, surgical technic and findings in more than 100 cases of hypertrophic arthritis of the knee joint. Through a medial parapatellar incision the patella is reflected and the joint is exposed. All roughened, degenerated cartilage, exostoses and loose bodies are removed to the bleeding bone. Postoperatively, the knee is dressed with pressure bandages and elevated on a pillow for three days. On the fourth day passive flexion is begun by means of a knee sling. On the eighth to the tenth day the patient's weight bearing and lessons in walking are supervised by the surgeon himself. After three or four days, the patient walks alone with two canes.

Bosworth [92] describes a method of fusion of the knee joint by means of a three-flanged nail. After the articular surfaces have been excised completely to produce cancellous bony contacts and after the patella has been counterscribed, a "vitallium" three-flanged nail is passed through the medial femoral condyle into the tibia. Ambulation with the extremity in a plaster cylinder and with the patient on crutches is permitted in three weeks. The author has performed the operation on 18 patients, including patients with Charcot's joints, arthritis, residual poliomyelitis, old suppurative arthritis, spastic hemiplegia in the aged and ligamentous relaxation; he also performed it after patellectomy. Fusion was obtained in 13 of the first 14 cases. In the other cases the operations were too recent to be reported on.

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90. Sutro, C. J.: Unilateral Tremor of Lower Extremity: Its Association with Internal Derangement of Ipsilateral Knee, New England J. Med. **235**:513-515 (Oct. 3) 1946.

91. Magnuson, P. B.: Technic of Débridement of Knee Joint for Arthritis, S. Clin. North America **26**:249-266 (Feb.) 1946.

92. Bosworth, D. M.: Knee Fusion by the Use of a Three Flanged Nail, J. Bone & Joint Surg. **28**:550-554 (July) 1946.

III. CONDITIONS INVOLVING THE FOOT AND ANKLE

Prepared by
EMIL D. W. HAUSER, M.D., CHICAGO

POTTENGER [93] has made an excellent study of nutritional disturbances in children. He presents an interesting series of roentgenograms which demonstrate alterations in bone structure due to a nutritional deficiency. As the deficiency is remedied, condensation of bone is demonstrable in the roentgenograms. These changes are shown in various stages of growth. In an article for the orthodontists he correlates the changes in the jaw which are due to malnutrition with changes which are seen roentgenologically in the bones of the foot and hand. The roentgenologic changes in the bones of the foot are extremely definite.

[ED. NOTE (E. D. W. H.)—This is a good paper. Orthopedists will be interested in learning more about the work which Pottenger is carrying out. Roentgenologic changes in the foot which are directly related to food deficiency are described as well as the correction of these changes by the administration of proper food.]

Sloane [94] describes an unusual anomaly of the foot in which the fourth metatarsal and the fourth digit were absent. There was a resultant alteration of the cuboid and cuneiform bones and a fusion between the calcaneus, cuboid and lateral cuneiform bones.

Magee and Benson [95] describe a fusion between the navicular and calcaneus and present roentgenograms.

Weitzner [96] presents a case report, illustrated by roentgenograms, of a talonavicular synostosis which was bilateral and congenital and was associated with hereditary multiple ankylosing arthropathy of the hands and wrists.

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93. Pottenger, F. M., Jr.: Fragmentation and Scarring of the Tarsal and Metatarsal Bones: An Index of Dental Deformity, Am. J. Orthodontics **32**: 486-515 (Aug.) 1946.

94. Sloane, M. W. M.: A Case of Anomalous Skeletal Development in the Foot, Anat. Rec. **96**:23-26 (Sept.) 1946.

95. Magee, R. K., and Benson, R. A.: Calcaneo-Scaphoid Bar, Canad. M. A. J. **55**:287 (Sept.) 1946.

96. Weitzner, I.: Congenital Talonavicular Synostosis Associated with Hereditary Multiple Ankylosing Arthropathies, Am. J. Roentgenol. **56**:185 (Aug.) 1946.

Wright, Greig and Anson [97] describe an accessory tendinous (peroneal) origin of the first dorsal interosseous muscle. They examined 125 specimens and found it present in 60 per cent. This is in accord with the findings of Harbeson, who first described this muscular slip from the peroneus longus tendon. They have an excellent drawing to show the position of this accessory interosseous muscle.

Rao [98] has written a good essay on infections of the foot. He points out the greater importance of infections of the foot in India as compared with western countries resulting from the fact that in western counties the foot is protected by boots and shoes whereas in India most persons go barefooted and thus their feet are more exposed to trauma and infections. He cites some statistics with regard to the number of infections of the foot which occur in India. He compares the treatment of infections of the foot with the treatment of infections of the hand and gives a complete and accurate description of the fascial spaces and the tendon sheaths, suggesting the best incisions for drainage.

Sundt [99] reviews the literature on division of the sesamoid bones of the foot and agrees with the majority of investigators that in most cases partition of a sesamoid bone is a congenital anomaly. He reviews the reports of histologic examinations in the literature and compares them with the histologic studies in 2 cases in which he removed the sesamoid bone. He is in accord with those authors who found changes in the sesamoid which are comparable to those in the juvenile osteopathies such as are seen in Köehler's or Freiberg's disease. He came to the decision that the changes in the sesamoid bone were the result of trauma of a chronic type, i. e., the effect of repeated daily irritation such as results from abnormal weight bearing.

[Ed. Note.—This article has some clinical importance. First of all, the bipartite sesamoid must be recognized as a not infrequent congenital anomaly and, second, the changes in the sesamoid may result from trauma. These changes may be the source of trouble even in the presence of other deformities, for example, hallux valgus.]

O'Rahilly [100] reports a case in which the fate of a supernumerary phalangeal epiphysis in the foot has been followed radiologically. The

97. Wright, R. R.; Greig, W., and Anson, B. J.: Accessory Tendinous (Peroneal) Origin of the First Dorsal Interosseous Muscle, Quart. Bull., Northwestern Univ. M. School **20**:339-341, 1946.

98. Rao, V. R.: Infections of the Foot, Indian J. Surg. **8**:1-19, (March) 1946.

99. Sundt, H.: On Partition of the Sesamoid Bones of the Lower Extremities. Acta orthop. Scandinav. **15**:59-138, 1944.

100. O'Rahilly, R.: Radiological Investigation of a Case of Pedal Hyperphalangism and Supernumerary Phalangeal Epiphysis, Brit. J. Radiol. **19**:432-434 (Oct.) 1946.

foot also showed hypophalangism and hyperphalangism, with subsequent symphalangism. Relevant cases from the literature are cited.

Pond [101] emphasizes the significance of the greater number of static disabilities of the foot among persons who wear shoes than among those who do not. The wearing of pointed shoes and high-heeled shoes tends to increase the percentage of disabilities. He also noticed that static disorders occurred more frequently among persons who stood a great deal than among persons who walked more. He had the opportunity to make a study of disorders of the feet among a group of soldiers in a convalescent camp, and he attempted to evaluate the functional capacity of the foot by determining the amount of out-toeing with which a person walked; the more out-toeing there was the weaker the foot. He then carefully adapted well fitting shoes and carried out corrections by means of functional exercises during which he attempted to have them walk normally. He started out by having them walk barefooted and then in the carefully fitted shoes, and he found that if he gradually increased the amount of walking he could increase their capacity. This treatment was continued until they were rehabilitated.

Hoshall [102] considers the common disabilities and the evolutionary process in the foot. He feels that this process is still going on and that the adaptation of the foot to constant level ground has not as yet taken place. He believes that when the first metatarsal bone is equally as long as or longer than the second, adaptation has taken place, since the foot is more stable. He also emphasizes the importance of incorrect foot wear such as the shoes the Chinese wore. It is the author's belief that the shoe should be adapted to the changes which are present in the foot. Various treatments for common disorders of the feet are discussed, including supports and surgical procedures as well as treatment for athlete's foot.

Funk [103] describes the occurrence of foot strain and the irritations in the metatarsal area which give rise to the symptom complex of metatarsalgia. For treatment he advises the use of the Thomas bar, which he explains in detail. He also describes flatfoot and the associated poor posture which is so frequently seen with it. For treatment he advises a pad in the region of the longitudinal arch and the Thomas heel with a raise on the inner side and a dutchman on the outer

101. Pond, A.: A Functional Approach to the Diagnosis and Treatment of Static Foot Disorders, Rocky Mountain M. J. **43**:459-463 (June) 1946.

102. Hoshall, F. A.: Disabilities of the Foot, J. South Carolina M. A. **42**: 117-119 (May) 1946.

103. Funk, H.: Everyday Orthopedics, Manitoba M. Rev. **26**:12-13, (Jan.) 1946.

side of the sole. For the severe cases of flatfoot he feels that the Schoolfield operation is the most reasonable since it corrects the valgus of the heel by shortening the deltoid ligament. When the arch is definitely low he uses the Miller operation to supplement that of Schoolfield.

Cozen [104] stresses the importance of tenderness over the center of the medial border of the longitudinal arch in cases of foot strain. He feels that this simple test, which is generally overlooked, has clinical value.

Truslow [105] emphasizes the relationship of foot strain to strains in other parts of the body. He cites cases in which symptoms in the back and in the hip were relieved by the application of mechanical corrections to the feet.

Bressler [106] made a study of the relationship between body weight and the incidence of flatfoot. He examined 4,322 college men, of whom 2,648 had structurally normal feet and 1,674 had flatfoot in some degree. He found that the flatfooted group were an average of 4.2 pounds (1.9 Kg.) heavier than those with normal feet. The flatfooted group also had a higher ponderal index. According to his conclusions, the incidence of flatfoot increases when there is excessive weight for the normal person as well as when the weight is normal but great.

Bonnet and Baker [107] made a study of the roentgenograms of the feet of 400 subjects in repose and bearing weight to determine the presence of pes planus. They measured the difference in the height of the lateral arches with weight bearing and without. They set up an arbitrary standard of arch measurement of 1 cm. or more during weight bearing as necessary to exclude the diagnosis of pes planus. In this study the incidence of pes planus was found to be higher in Negroes than in white persons and, contrary to the findings of other investigators, overweight was not a factor in the incidence of pes planus. They also checked the descent of the medial arch in flat feet and in normal feet and found it comparatively the same.

[Ed. Note.—This method of measuring arches has been tried before. I have tried it and found that there were variations, but I did not find them consistent with clinical findings. I do not feel that this method of measuring is reliable in its present form.]

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104. Cozen, L.: Foot Strain: A Valuable Sign, California & West. Med. **64**: 82 (Feb.) 1946.

105. Truslow, W.: Relationship of Foot Strains to Other Body Strains, M. Times, New York **74**:275 (Oct.) 1946.

106. Bressler, J. Body Weight and the Incidence of Flat Feet, Research Quart. **17**:102-113 (May) 1946.

107. Bonnet, W. L., and Baker, D. R.: Diagnosis of Pes Planus by X-Ray, Radiology **46**:36-45 (Jan.) 1946.

Bailey and Harrens [108] observed the alteration of the foot in pes valgoplanus in which the heel is in the valgus position and the first metatarsal bone displaced dorsally. To correct this deformity they provided an apparatus which was mounted on a roller base, which tends to bring the foot into normal position and can be used while the patient is sitting down.

Compere [109] discusses flat feet in children. He takes up the problem of chronic strain and describes the interference with the development of the foot caused by its encasement in a stiff leather shoe. Correction of the foot is done by means of a shoe with the Thomas heel, and the weight bearing is altered through the knee by raising the inner side of the heel. This can influence in a corrective way the valgus of the foot as well as a valgus of the knee.

Thomson [110] emphasizes the importance of correcting congenital flatfoot and describes the use of the reverse Denis-Browne splint for correction. This can be used before the child walks by strapping the foot onto the splint and later by fastening the splint to the shoes. He reports gratifying results in a series of 50 cases.

Wallgren [111] estimates that congenital flatfoot occurs in about 1 in 1,000 persons in Finland. He advises early treatment, preferably ten days after birth. The deformity is reduced manually and the position is retained by means of an elastoplastic bandage. If the treatment is started in time, five to six weeks should be sufficient for a good result.

Lapidus [112] presents a review of the literature on spastic flatfoot. According to his theory, spastic flatfoot is the result of a lesion of the interosseous talocalcanean ligament or of the subtalar joint, with a reflex spasm of the pronators to produce relaxation of the involved ligament. For this reason he advises against operations which are specifically designed to eliminate the pronator action of the peroneal group whether by division of the nerve or by division of the muscle.

[ED. NOTE.—I am in accord with this conception and have found that the reflex spasm can be relieved in many instances by an injection of procaine hydrochloride into the talocalcanean ligament. Repetition of the injection will bring about a subsidence of the spasm, and the foot can be brought into normal position. If it is protected, the inflammation will subside and the result will be final cure.]

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108. Bailey, E. T., and Harrens, B. S.: Remedial Correction of Valgus Foot Strain by Foot Pronation Exercise, Lancet **2**:490-491 (Oct. 5) 1946.

109. Compere, E. L.: Flat Feet in Children, M. Clin. North America **30**: 147-154 (Jan.) 1946.

110. Thomson, J. E. M.: Treatment of Congenital Flat-Foot, J. Bone & Joint Surg. **28**:787-790 (Oct.) 1946.

111. Wallgren, G.: Treatment of Congenital Flatfoot, Acta chir. Scandinav. **93**:417-423, 1946.

112. Lapidus, P. W.: Spastic Flat-Foot, J. Bone & Joint Surg. **28**:126-136 (Jan.) 1946.

Chambers [113] attributes flexible flat feet of adolescents to the abnormal anatomic arangement of the talocalcanean facets and says that the condition can be eliminated by obliterating the sinus tarsi of the calcaneus by means of a bone grafting operation which he describes.

[Ed. Note.—With reestablishment of normal muscle strength and balance by means of normal function, I have found operative intervention to be unnecessary. In cases of onychogryphosis and subungual exostosis, Stewart [114] removed the offending nail and the projection of bone, and after destroying the nail bed he applied a skin graft. In this way he obtained a good cosmetic result and relatively rapid healing.]

Perrot [115] objects to the resection of the head of the first metatarsal bone in the correction of pes valgoplanus since it is an important mechanical support in the normal foot. He prefers a resection of the proximal part of the phalanx of the great toe and follows the technic of Brandeis, with good cosmetic results. In an exceptional case he uses the Hohman procedure, which is an osteotomy for correction of the deformity of the first metatarsal.

Glissan [116] describes a technic for the correction of hallux valgus in which he reflects the extensor tendon, strips the periosteum of the first metatarsal bone and performs a wedge osteotomy just posterior to the head. The deformity is then corrected, and the periosteum, fascia and skin are closed. He holds the position by means of an aluminum splint held in place with plaster of paris. In cases of hallux rigidus he fuses the metatarsophalangeal articulation, and he reports satisfactory results in the majority of cases.

[Ed. Note.—I think it is much better to resect the base of the first phalanx in cases of hallux rigidus. It is simpler and gives a more satisfactory result.]

DeNicola [117] describes sprains in which there is a momentary dislocation of the talus and feels that after the dislocation is reduced the amount of injury to soft tissue is frequently overlooked. The severity of the injury can readily be tested by injecting an anesthetic agent into the injured ankle; with the foot in complete inversion there is a subluxation of the talus. This can be demonstrated in roentgenograms.

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113. Chambers, E. F. S.: An Operation for the Correction of Flexible Flat Feet of Adolescents, West. J. Surg. **54**:77-86 (March) 1946.

114. Stewart, J. H.: Surgical Treatment of Deformities of the Hallux by Skin-Grafting, Brit. M. J. **2**:329-330 (Sept. 7) 1946.

115. Perrot, A.: Pied plat transverse et hallux valgus: Pathogénie et traitement, Schweiz. med. Wchnschr. **76**:362-366 (April 27) 1946.

116. Glissan, D. J.: Hallux Valgus and Hallux Rigidus, M. J. Australia **2**: 585-588 (Oct. 26) 1946.

117. DeNicola, R. R.: Sprain or Momentary Dislocation of the Talus? Occup. Med. **2**:214-218 (Sept.) 1946.

This is a severe injury and should receive adequate treatment, and the author suggests that the ankle should be kept for from five to eight weeks in a plaster of paris cast.

[ED. NOTE.—Sprains vary in severity from this type of complete tear with dislocation to minor tears with slight irritation. Treatment should be according to the extent of the injury. In the severe cases a cast should be applied for fixation and then the foot rehabilitated. When slight injury causes reflex spasm, injection after the manner of Leriche is not only adequate but is better treatment than fixation.]

King [118] discusses the pathologic process in Morton's metatarsalgia. He investigated the histologic changes in tissue removed in 5 cases and found that there was increased connective tissue, decrease of nerve bundles and a thickened perineurium. He suggested the term "sclerosing neuroma" for this type of lesion.

Dieterle and Kuzma [119] describe a case of Morton's metatarsalgia in which relief was obtained by removal of a diffuse mass of glistening white tissue found beneath the third and fourth toes. Microscopically it was made up of hyalinized connective tissue in which were embedded thick-walled arteriolar branches and a number of nerve bundles. The vessels showed subintimal fibrosis and were accompanied externally with thickened connective tissue. Special stains showed degenerative changes in the neural fibers. The authors felt that the entire complex of connective tissue involvement of the nerve bundles and subintimal fibrosis producing endarteritis can reasonably be interpreted as a reaction to trauma.

Winkler and Feltner [120] report 12 cases of metatarsalgia in which they operated and found that there was a spindle-shaped thickening of the plantar nerve. They found that most of the histologic changes were in the connective tissue rather than in the nerve. The perineurium was thickened and hyalinized. Their findings are in agreement with those of Baker and Kuhn, who believe that the process is essentially degenerative in nature and that trauma is the most likely cause.

Schwartz [121] made a thorough study of the disabilities of the foot which are most effectively corrected by arthrodesis of the subtalar and midtarsal joints. He stresses the importance of careful analysis of

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118. King, L. S.: Note on the Pathology of Morton's Metatarsalgia, Am. J. Clin. Path. **16**:124-128 (Feb.) 1946.

119. Dieterle, J. O., and Kuzma, J. F.: A Case of Morton's Metatarsalgia (Morton's Toe) Treated by Operation, Wisconsin M. J. **45**:967-968, (Oct.) 1946.

120. Winkler, H., and Feltner, J. B.: Morton's Metatarsalgia, Bull. Charlotte Mem. Hosp. **2**:9-12 (Sept.) 1946.

121. Schwartz, R. P.: Arthrodesis of Subtalus and Midtarsal Joints of the Foot, Surgery **20**:619-635 (Nov.) 1946.

the condition of the foot before the operation is undertaken. The requirements of the operation in the individual case can then be fulfilled. To make the execution more feasible he devised an incision which assures excellent exposure and results in primary healing. He analyzed cases in which this method was used and compared them with those in which the arthrodesis was carried out through a smaller incision. He found that the results were better after the more carefully planned operation.

Anderson [122] describes a transmalleolar approach for arthrodesis of the ankle joint in which he excises both malleoli. This provides access to the entire joint under direct vision, and the joint can easily be resected. Resection of the malleoli gives a narrow, shapely ankle. He obtains immobilization by means of transfixion pins, either with or without a cast. He reports good results.

Schmier [123] reviews the disabling lesions of the foot as he saw them in the army. He discusses prevention of the common disorders by the use of proper shoes and hosiery and recommends light woolen socks and a correct military shoe. He outlines the treatment of ordinary blisters, ingrown toe nails, corns, calluses and athlete's foot. In the treatment of static disabilities he uses the Thomas heel with a raise of ⅛ to ¼ inch (0.32 to 0.64 cm.) and either rigid or flexible arch supports. He found exercises all important in strengthening the muscles which elevate the arch. In cases in which there were peroneal muscle spasm and rigidity of the foot he recommended a certificate of disability discharge. Surgical procedures to correct this deformity are not carried out in the army. For static foot strain in the region of the metatarsal arch he used transverse bars. In a discussion of march fracture he emphasizes the advantages of early recognition and proper treatment. Relief was obtained by discontinuing weight bearing, and satisfactory results were obtained when the patient was kept three weeks in bed with or without a cast. In case of multiple fracture a plaster of paris cast was applied to prevent deformity, and after callus was seen in the roentgenogram weight bearing was gradually permitted and the patient was returned to regular duty. Transverse bars and Thomas heels as well as "longitudinal cookies" were applied. Patients with pes cavus, apparently irrespective of the cause, were recommended for duty without field service or for certificate of disability discharge, depending on the severity. Patients with fractures of the metatarsal bones following a parachute jump were immediately put to bed, and the results were extremely satisfactory. Painful heels were usually due

122. Anderson, R.: Concentric Arthrodesis of the Ankle Joint, J. Bone & Joint Surg. **27**:37-48 (Jan.) 1945.

123. Schmier, A. A.: The Foot Problem as Seen in Soldiers, Am. J. Surg. **72**:668-678 (Nov.) 1946.

to bursitis or spurs. The bursa was excised and the spurs removed. Operation for hallux valgus was not carried out. Tenosynovitis was treated by rest and relief of pressure.

[ED. NOTE.—This is an article of value because it shows actual experience with these common conditions of the foot in the service.]

Trench foot is described by Toone and Williams.[124] They urge recognition of the danger of the condition and suggest that proper equipment be issued to protect the foot, including waterproof boots with woolen socks and a fresh supply of dry socks daily. The effect of this preventive medicine was established in the low incidence of trench foot during the winter campaign in the Apennines.

The postwar aspects of the problem of trench foot are described by Latimer.[125] He reports the pathologic findings and the signs and symptoms of the late stage of trench foot. He believes that much of the change is due to degeneration and regeneration of nerves, muscle atrophy and fibrosis rather than to damage to the blood vessels.

Paddock [126] found that in the late stages of trench foot the symptoms were due more to the nerve changes than to the vascular changes.

According to a study made by Spealman [127] of feet maintained at temperatures below 12 or 14 C., hyperemia, swelling and pain occurred quickly but serious injury did not occur rapidly at temperatures near the upper limit of this range. Feet maintained at an average temperature of 12 C. for thirty hours recovered quickly. By means of a thin layer of good insulating material, feet immersed in ice water were maintained at a temperature of from 12 to 14 C., at which temperature immersion foot does not occur rapidly. However, exceedingly large quantities of insulation were needed to keep feet above the temperature at which immersion foot may occur if exposure is sufficiently prolonged. When the body was kept warm, the feet, encased in the insulation described and immersed in ice water, remained much of the time above the temperature at which injury by cold occurs. Petrolatum did not appear to afford any great protection of feet immersed in cold water. Exercising the foot seemed of value and should be of aid in preventing immersion foot.

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124. Toone, E. C., and Williams, J. P.: Trench Foot: Prognosis and Disposition, Bull. U. S. Army M. Dept. **5**:198-210 (Feb.) 1946.

125. Latimer, J. W.: Postwar Aspects of the Trench Foot Problem, M. Clin. North America **30**:421-429 (March) 1946.

126. Paddock, F. K.: Chronic Disability in Mild Cases of Trench Foot, New England J. Med. **234**:433-437 (March 28) 1946.

127. Spealman, C. R.: The Protection of Feet Immersed in Cold Water, U. S Nav. M. Bull. **46**:169-178 (Feb.) 1946.

Sargeant [128] found that in the Solomon Islands fungous infection outnumbered all other conditions of the feet. Most of the time was spent in trying hygienic measures to prevent its inception, and weekly inspections were made so that care could be instituted early.

Gopalan,[129] Cruickshank [130] and Page [131] describe in separate papers a symptom complex which gave rise to a burning pain in the feet. Redness and swelling in the feet, similar to erythromelalgia, occurred. This condition was due to a vitamin B deficiency, and when nicotinic acid and riboflavin were given the symptoms all subsided.

Van Demark and McCarthy [132] report a case of Panner's metatarsal disease and present a series of roentgenograms. A 25 year old infantry recruit complained of pain in the foot. March fracture was suspected. The initial roentgenogram was normal. One month later another roentgenogram revealed reaction of the subperiosteal bone of the distal metatarsal shaft. A third roentgenogram, made six weeks after the second, revealed cystic changes in the head of the metatarsal. A roentgenogram made ten months after onset of the symptoms revealed deformity and marked cystic changes in the metatarsal head. This constitutes Panner's syndrome, described by Köhler and Panner. It is to be differentiated from march fracture from both prognostic and therapeutic viewpoints. A certain rigidity and mild pain persist in the affected metatarsophalangeal joint as a result of the aseptic necrosis of the metatarsal head. Patients with this condition do not respond to the ambulatory type of treatment which has proved satisfactory in most cases of march fracture.

Southworth [133] has used block of the sympathetic nerves and sympathectomy in the late stage of immersion foot. He has also used it for frostbite. He has used repetition of paravertebral block and the injection of alcohol as well as the actual surgical extirpation of the nerve. He advises this in cases in which there are cutaneous sensitivity and circulatory insufficiency. He states that pain, which is often the chief

128. Sargeant, E. H.: Fighting Foot Trouble, Hosp. Corps Quart. **19**:24-25 (June) 1946.

129. Gopalan, C.: Burning Feet Syndrome, Indian M. Gaz. **81**:22-26 (Jan.) 1946.

130. Cruickshank, E. K.: Painful Feet in Prisoners-of-War in the Far East, Lancet **2**:369-372 (Sept. 14) 1946.

131. Page, J. A.: Painful Feet Syndrome Among Prisoners of War in the Far East, Brit. M. J. **2**:260-262 (Aug. 24) 1946.

132. Van Demark, R. E., and McCarthy, P. V.: Panner's Metatarsal Disease: A Condition of Aseptic Necrosis Simulating March Fracture, J. Bone & Joint Surg. **28**:842-844 (Oct.) 1946.

133. Southworth, J. I.: The Role of Sympathectomy in the Treatment of Immersion Foot and Frostbite, New England J. Med. **233**:673-681 (Dec. 6) 1945.

complaint, is not affected by sympathectomy, physical therapy or mechanical devices. Whether he uses temporary block, alcohol injection or excision depends on the severity of the symptoms. He uses the Flowthow approach for lumbar sympathectomy. His technic for the block of sympathetic nerves in the thoracic region is to have the patient in a lateral prone position and then inject procaine hydrochloride through a wheal placed opposite the seventh dorsal vertebra. The needle is inserted medially until the transverse process is met and then worked past its inferior border down to the lateral aspect of the vertebral body. Aspiration is done to avoid subarachnoid injection. Four cubic centimeters of absolute alcohol is introduced when the needle is properly placed. The position of the needle can first be tested by the injection of 2 cc. of procaine hydrochloride; if the needle is placed correctly, basal dilatation occurs.

Copleman, Vidoli and Crimmings [134] report 3 cases of solitary cyst of the calcaneus. A study of their cases and comparison with similar cysts described in the literature led the authors to the conclusion that the condition is a dysplasia occurring in adolescence as a result of multiple traumas.

[ED. NOTE.—I have seen these cysts in 3 or 4 cases and have had the same experience. Three of them gave no trouble at all, and I found it advisable to curet only one. I found that the removal of foot strain relieved the symptoms in other cases.]

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134. Copleman, B.; Vidoli, M. F., and Crimmings, F. J.: Solitary Cyst of the Calcaneus, Radiology **47**:142-148 (Aug.) 1946.